UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL MARKETING SERVICE

AGRICULTURAL ESTIMATES DIVISION

Report on . . .

1954 RESEARCH SURVEYS

BY

THE RESEARCH AND DEVELOPMENT STAFF

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Table of Contents

Continued -

Table of Contents - Cont.

1. Introduction

In June 1952, a Special Subcommittee of the Committee on Agriculture of the House of Representatives made a number of helpful recommendations on the procedures used by the Crop Reporting Service of the Department of Agriculture. One of the most specific was that a program of research and experimentation be conducted on a larger scale and that a research unit charged with making such studies be established.

When funds to start such a program were later made available, the Bureau of Agricultural Economics, in which the Agricultural Estimates Division was then located, appointed a Panel of Consultants consisting of prominent statisticians and agricultural economists to review studies already in progress and to help frame a long-range program. As might be expected, the views expressed in discussions with the Panel covered a wide range of topics and individual members differed among themselves on studies which should receive the most emphasis in the immediate future. Some members, for example, felt that the work should take the direction of establishing sounder probability sampling methods in surveys. Others felt that most improvement in the present system would result from studies on objective methods of forecasting crop yields. But there was general agreement that the studies should be of a highly practical nature, that they should be conducted as nearly as possible under practical operating conditions over wide geographic areas, that provision should be made for systematically incorporating results of studies into the regular operating program and that a research staff be established to conduct these studies. A research staff composed of Walter A. Hendricks, Raymond E. Vickery and Harold F. Huddleston has been established in the Division.

After several meetings were held with the Panel, it was concluded that the over-all objectives could best be met by a continuing research program which would include studies on both sample-survey procedures and objective crop-forecasting methods. It was decided to start such a program in 10 Southern States and to expand it to the rest of the country, region by region, as fast as practicable over the next few years. It was suggested that a probability area sample be interviewed in June, in a simulated operating program, to estimate livestock numbers and planted crop acreages. Subsamples of those farms would be visited periodically during the growing season for plant observations to be used in objective yield forecasts, such observations to be limited to cotton, corn, and wheat in the early stages. Mail surveys, using all farms interviewed in the June survey, would be conducted parallel with the Division's large acreage and livestock surveys to study the possibilities of putting such surveys on a more scientific footing.

It was also recommended that research studies which have been conducted cooperatively with the Statistical Laboratories of Iowa State College and North Carolina State College for many years should be closely integrated with such an overall research program. It was decided that the projects to be conducted at the Laboratories should be intensive studies of problems that would be likely to arise in the extensive surveys listed above. Work at Iowa State College was

consequently directed toward studies of within-field sampling techniques for objective data on corn yields, studies of the validity of farmers' reports on corn acreages and final production, and studies on subjective and objective forecasts of corn yields. Work at North Carolina took a similar direction on cotton.

2. Summary and Conclusions

A basic interview survey was conducted on a sample of about 3,000 farms in 703 sample area segments in 100 sample counties of the 10-State Southern region as of June 1954 to study sampling and interviewing problems encountered in such surveys. It had been decided to use the place of residence of the farm operator as the criterion of whether or not a farm is "in" a selected sample area segment. If the operator lived inside a selected segment, his farm was in the sample regardless of where the land was located. As many operators of farms live in urban areas, it was necessary to draw sample segments from such areas as well as from the open country. One of the important results from the survey data was the discovery that more farm operators than had been anticipated live in towns and cities. It was found that area segments of the size used in the survey often picked up "pockets" containing extremely large numbers of farm operators in urban areas. Such segments were also hard to canvass because of the large numbers of dwellings present. To eliminate operating difficulties, and to reduce sampling errors contributed by the incidence of urban segments containing extremely large numbers of farm operators, it would be desirable to make urban sample segments much smaller.

In the survey farm managers were considered to be operators. It was found difficult in many instances to determine whether or not a man who called himself the manager should actually be considered the manager according to definition. For that reason it was concluded that in future work the owner or lessee of the land should always be regarded as the operator, even when it was stated that another person served as "manager".

Croppers were not considered to be operators. Respondents were asked to report for all land they operated, including that assigned to croppers, but to exclude data for land rented out to bona fide cash or share renters. It was discovered that even though the respondents correctly deducted land rented out in reporting the scope of their overall operations, they sometimes reported crops on such land in reporting their crop acreages. Such over-reporting seemed to be particularly serious for crops grown on shares by renters. Because of such over-reporting, direct expansions of the survey data to estimated universe totals were too high for the items affected. But "percent-change" indications, derived from historical data for the previous year which were asked on the questionnaire, were at the correct level. Apparently respondents were consistent in their concept of what constituted their farming operations. It was concluded that the best solution to this problem in the future would be to permit the respondent to report data for all land under his control, including that rented out to bona fide renters. He would then be questioned about the operations of his tenants in sufficient detail so that his own operation and those of his tenants could be properly segregated according to definition when the data are tabulated.

Mail surveys were conducted in late September and November on the entire list of farm operators interviewed in June to obtain data on crop production and livestock numbers. Several hundred nonrespondents to the mail surveys were interviewed. The percentage response to the mail surveys was much lower than

anticipated--about 17 percent and 20 percent in the two surveys. Furthermore, there was often little comparability in the scope of the farming operations covered by the reported data in the mail surveys and in the June interview for individual farms. It has been suggested that the percentage returns and comparability of data could both be improved if pertinent data from the June survey were inserted in the mail questionnaires before they were sent to the farmers. That should avoid possible irritation from asking the same questions over again on some items and should help to maintain comparability of reported data. But even though there was lack of comparability between data reported in June and data reported in the mail surveys, the data reported in the mail surveys were comparable between items. Ratios of reported harvested crop acreages to reported planted acreages, and similar computations, apparently were valid. This is in accord with experience gained from other surveys conducted by the Division.

The studies on objective yield estimates and forecasts indicate much promise. In the 10 Southern States a sample of 200 cotton fields was visited for plant observations as of August 1, September 1, and after harvest. A similar sample of 200 corn fields was visited as of September 1, October 1, and after harvest. In retrospect, it is now apparent that the timing of visits to the corn fields should have been the same as for cotton. Much of the corn was already mature by September 1 and little information could be obtained on the relationship of observations on immature corn to final yields.

But it was possible to study the relationship of yields estimated from weights of small preharvest samples to yields reported by farmers and to obtain data on normal harvesting losses. The results were consistent with results from preharvest yield surveys conducted by the Division in previous years and with results obtained at Iowa State College. The acreage on which corn was actually standing for harvest was 2.2 percent less than farmers' reported acreage and the harvesting loss was about 10 percent of the objective yield indication. Adjusting the data for these factors to make them comparable with farmers' reported yields still left a difference of about 15 percent between objective and reported yields.

Objective plant observations on cotton indicate that fruit counts as of a given date may be more reliable indications of yield than growers' judgment appraisals. Forecasting equations were developed from the data and will be used for experimental yield forecasts during the coming season. The basic procedure involves forecasting the number of bolls that are likely to reach maturity by harvest time, applying the average weight of cotton per boll to that forecast, and making a deduction for normal harvesting loss. In 1954 the harvesting loss of open cotton amounted to about 4.5 percent and about 4.5 percent of the total bolls counted on September 1 failed to reach maturity.

Cotton research at North Carolina State College was directed mainly toward finding optimum methods for sampling within fields, verification of reported cotton acreages, and intensive studies on yield forecasting. Results show that double 10-foot row sections are efficient sampling units and that acreage measurements made on the ground agree closely with farmers' reported acreages.

Measurements made on aerial photographs seemed to have an upward bias. On the average, official ASC measurement data were lower than any of the other figures. A number of regression equations relating fruit counts to yields were computed but the results are not yet conclusive.

Corn studies at Iowa State College were concerned mainly with sampling methods for estimating yields from preharvest samples and with attempts to reconcile differences that have always arisen between yields estimated from such samples and yields reported by farmers. In general, results were in agreement with those obtained in the objective yield surveys conducted in the 10 Southern States and with similar studies conducted elsewhere in previous years. But in addition the volume of corn found in farmers' cribs was measured after harvest and compared with the farmers' estimates of the bushels of corn in those cribs. Results indicate that the farmers' estimates were about 15 percent too low. This suggests that the unexplained difference between objective yield estimates and reported yields that has always been encountered, even after making appropriate adjustments for acreage and harvesting losses, may be caused by rather consistent under-reporting of production by farmers. 1/

1/ See Hendricks, Walter A., "Validity of objective estimates of corn yield," Agricultural Economics Research 7(3): 69 - 72, July 1955.

3. June Acreage and Livestock Survey

3.1 Purpose

This survey was made as part of a broad research program aimed at developing an improved crop and livestock reporting system. The system visualized in connection with this survey consists of a probability area sample of farms being interviewed in June of each year to obtain data on planted crop acreages and livestock inventories, with objective plant observations and farmers' appraisals of crop prospects and final yields being obtained for important crops on a subsample of those farms at monthly intervals during the growing season, and with mail surveys being made on the entire sample during the year to estimate harvested crop acreages, final crop production, and end of year livestock inventories. Studies leading to the development of an improved system, which is at present assumed to be of that general character, are being conducted under simulated operating conditions in the belief that this is the most efficient procedure for studying the suitability of proposed methods and for incorporating the results of the studies in the regular operating program.

Sample data were expanded by two methods (1) direct expansion based on the reciprocal of the sampling rate and (2) "percent change" applied to 1953 Board estimates for items on which information was obtained for both 1953 and 1954.

3.2 Summary and Recommendations

An initial probability area sample of about 3,000 farms in 100 sample counties of Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, North Carolina and South Carolina was interviewed during the first two weeks of June.

The expansions indicate that farmers are consistent in what they consider as their crop acreages from year to year and that reliable estimates of year to year changes can be made from a fairly small probability area sample when acceptable benchmarks, such as measured acres of allotment crops, are available. The direct expansion of number of farms, counting croppers as farms, is only about 3 percent higher than the Board. The expanded total land in farms is about the same as the Board figure. But the direct expansions of all major crop acreages and cattle numbers are consistently too high.

Major factors which caused the overexpansion are believed to be:

1. Sampling error. The sampling fraction was 1/620 for the non-wheat counties and 1/215 for the wheat counties. Nonopen country segments made up 3.6 percent of the total segments but they contained 15 percent of the farm operators. Many of these were operators of large cotton farms. This increased the sampling error unduly.

2. Some farmers apparently reported crops on land rented out to share tenants or for standing rent. This would have the effect of double reporting of crop acreages.

3. Some ineligible farm operators were included in the sample. This would seem to be a minor problem since the total number of farms and total land in farms are about in line with check data. However, some ineligible farms were found to be present when the objective yield measurements were made on cotton and corn.

It appears that with the limited resources available for 1955 most effort should be concentrated on reducing within-county sampling errors and eliminating nonsampling errors. To accomplish this the following steps are under consideration:

1. Enumerate all "large" cotton, corn, wheat, and livestock farms in the 100 sample counties.

2. Increase the number of non-open country segments but reduce their size.

3. Make a quality check on the June 1955 enumeration by using the "closed segment" approach on a sample of segments; i.e., account for the use of all land and for all livestock kept or housed within the segment.

4. Clarify definitions of farm operators and croppers and emphasize the need for more careful screening of managers and non-resident operators by enumerators.

5. Use a "balance sheet" type of schedule to account for the use of all land in the farm, to eliminate crops on land rented out, and to insure that all land rented in, for which crops are reported, is included in the reported farm land.

3.3 Design of the Sample

The 10-State region contains 985 counties (as constituted in the Master Sample material) and 2,101,012 farms as of the 1950 Census. In drawing samples of counties for earlier surveys conducted by the Bureau of Agricultural Economics, these counties had been grouped essentially by Sub-Types of Farming (Farm Type Classification) within States. In this survey all such groups for each of the 9 major Farm Type categories were listed by States under the major Farm Type. The Farm Type III (wheat) category contained 33 counties and 37,590 farms (1950 Census). All other Farm Type categories contained 952 counties and 2,063,422 farms. It was decided that the work load in each county chosen for the sample should be such that one interviewer assigned to the county could complete his interviews in about two weeks. To achieve that objective it appeared that the sample farms should be distributed over 100 counties and that those counties should be selected with probabilities proportional to numbers of farms present. A uniform sampling rate applied to the selection of 100 counties from the universe of 985 would mean taking one for every 21,010 farms. As the Type III counties contain only 37,590 farms, only about 2 such counties would be selected. As objective yield forecasting studies were planned for wheat, it seemed desirable to have at least 5 such counties in the sample to provide enough wheat farms for those studies. For that reason it was decided to draw 5 Type III counties for the sample. As the June survey was to be largely a general-purpose survey, a uniform sampling rate was applied to the other strata for the selection of the remaining 95 sample counties.

The selection of the sample counties was performed by listing all counties in the universe by major Farm Types as described earlier and recording the 1950 Census farm count for each county. Cumulative totals were computed separately for the Type III stratum and for the stratum containing all other Farm Types. In the Type III stratum a county was selected for every cumulative 7,518 farms after a random start; in the other stratum counties were selected with a sampling interval of 21,720 farms. These intervals were set to yield a sample of 5 Type III counties and 95 of the other Types. After this sample of 100 counties was selected it was discovered that 8 were counties already being used by the Census Bureau in the CPS sample. Alternates for those were drawn in each State where duplications occurred by making a random selection with equal probabilities from among those counties in the State which were similar to the county originally chosen with respect to total number of farms and total population. The latter requirement seemed desirable because the Census CPS counties usually contained large cities.

As indicated earlier, a total sample of about 3,000 farms was desired. But in this survey it was decided not to count cropper operations as farms. This means that more than 30 farms (as farms are defined in the Census) needed to be selected per county. To reach the desired number of farms (as farms are defined in the survey), and to keep the data for individual counties properly weighted, the equivalent of 35 farms (as defined in the 1950 Census) needed to be taken in each selected county. The number of sample segments selected in each sample county was thus set to yield an expected 35 Census farms. It was discovered that the Master Sample area segments for the Southern States contained an average of almost 10 Census farms per segment. To achieve more dispersion of the sample farms within

counties, the segments used in this survey were only one-half the size of the Master Sample segments. New maps and aerial photographs were used to delineate the segments. Altogether 703 sample segments were selected for enumeration, yielding an average of about 5 Census farms per segment.

3.4 The Questionnaire

Two forms were used in the survey: (1) a Farm Identification form designed to screen persons living inside the boundaries of each segment to determine whether or not they were farm operators, and (2) a farm questionnaire to be filled out for all persons who qualified as farm operators. In this survey a farm questionnaire was filled out for every person living inside the boundaries of a sample segment who qualified as an operator of a farm, regardless of where the land he operated was located. To qualify as a farm operator a respondent had to meet rigid specifications but the entire burden of making the decision did not rest upon the interviewer. The interviewer was instructed to complete a farm questionnaire for every place that the operator called a farm and for every place not considered a farm by the operator, if, during 1954, any poultry or livestock were kept or grazed, any fruit or vegetables were grown for sale, or any other crops were grown. The farm questionnaires were reviewed in the Washington office after the survey was completed and more rigid rules applied to determine which of these places should be considered to be farms. A place was called a farm if it scored 150 points according to the following rating system, which was adapted from rules already used by the Census Bureau.

	Points allowed	
	Places of 3 acres or more	Places of less than 3 acres
Hay or pasture: Each acre	30	0
Vegetables or small fruits for sale: Each acre	150	150
Cotton, tobacco, Irish potatoes, sweet potatoes: Each acre	150	150
Other crops harvested: Each acre	50	50
Fruit: Each acre	150	150
Cattle (excluding calves) on hand: Per head	150	50
Calves on hand: Per head	50	30
Hogs and pigs on hand: Per head	50	25
Sheep and lambs on hand: Per head	30	18
Chickens on hand: Each	3	2

In the enumeration a place was defined as all land operated. This included land owned, plus land rented in, and minus land rented out to tenants other than croppers. Croppers were not considered to be farm operators. In this survey a cropper was defined as a person who worked land for others for a share of the crop, with all horses, mules, or tractor power to work the land being supplied by the landlord. To qualify as an operator a person had to be responsible for the day-to-day decisions in the agricultural operations, regardless of whether or not he actually lived on the place. Bona fide tenants were considered operators; share tenants qualified as operators if they furnished their own workstock or tractor power. Managers were considered operators when they actually made all major decisions with respect to the operation. When a manager operated land simultaneously for different people, the aggregate was treated as a single farm. But if in addition to managing land for others he also operated some land for himself, the land operated for himself was considered a separate farm. In the case of a partnership with both parties living on the place the partner responsible for most of the decisions was considered the operator; when no such distinction could be made, the older was designated. When only one partner lived on the place, he was considered the operator.

The farm questionnaire was of the interview type and consisted of 17 pages in book form and about 150 questions. This may seem quite lengthy, but it must be remembered that the questions were of the interview type so that an interviewer could run through them quite rapidly. Furthermore, only a comparatively small number of questions needed to be asked of every farmer; sections on items not applicable could be skipped in toto. Most of the questions related to planted crop acreages and livestock inventories. Acreage for harvest and production data were obtained for crops normally harvested in late spring and early summer. Data on 1953 acreages and production were asked for some of the important crops to provide a basis for ratio estimates. It was anticipated that a direct expansion of 1954 data from such a small sample would be subject to rather large sampling errors and that considerable improvement would result from the use of ratio estimates.

In addition to these questions, several others were included to shed light on how farmers interpret some questions asked in this survey and in the regular surveys conducted by the Division. There has always been some doubt, for example, about the units in which farmers report corn yields. In this survey farmers were asked specifically whether they were reporting corn production in terms of bushels of ear corn or shelled corn and how many pounds were regarded as a bushel. Another troublesome question in the regular livestock surveys has always been whether a farmer's report on "pigs saved" includes pigs which were sold or given away, as well as those which he kept to raise himself. In this survey every respondent was asked whether or not such pigs were included. If not, he was asked how many pigs were omitted in his reported figure.

It was generally assumed that farmers with croppers would prefer to report crops grown by croppers as part of their own operations. But, to insure that data for croppers were included, the operator was asked specifically whether his reported crop acreages included acreages worked by croppers. When they were

omitted, the operator was asked to report on them also. In the case of livestock the operator was asked specifically to report the total number of cattle and hogs on the place, including those kept by croppers. He was then asked specifically for the numbers kept by croppers only, but detailed questions on such matters as ages of animals and milk production were not asked for stock kept by croppers. It was assumed that the operator would not be well enough informed to answer such questions and that the numbers of such animals were not large enough to justify contacting the croppers themselves for the data.

3.5 Distribution of Farm Operators by Segments

The number of farm operators found in the area segments is of administrative and statistical interest. That distribution for the present survey is shown in Table 3.1.

Table 3.1 - Numbers of Segments Containing Specified Numbers of Farm Operators

Farm Operators	Number of Segments	Farm Operators	Number of Segments
0	42	11 - 15	18
1	94	16 - 20	6
2	126	21 - 25	1
3	134	26 - 30	0
4	110	31 - 35	0
5	61	36 - 40	1
6	40	41 - 45	0
7	24	46 - 50	0
8	26	51 - 55	1
9	10	- - - -	- -
10	8	113	1

There were only 4 segments containing more than 20 farm operators.

For the 661 segments containing farm operators, the frequency distribution of segments by acres of farm land is shown below.

Table 3.2 - Segments Classified by Acres of Farm Land Associated with Segments

Farm Land per Segment acres	Number of Segments
1 - 999	523
1,000 - 2,999	111
3,000 - 4,999	10
5,000 - 6,999	7
7,000 - 8,999	4
9,000 - 10,999	2
11,000 - over	4
Total	661

The 4 segments in the last category consisted of 1 with 14,325 acres of farm land, 1 with 24,334 acres, 1 with 37,442 acres, and 1 with 39,099 acres.

Table 3.3 - Operators and Segments by States

State	Number of Segments	Number of Operators
Ala.	66	239
Ark.	69	241
Ga.	62	216
La.	29	150
Miss.	71	248
N. C.	86	362
Okla.	67	247
S. C.	48	204
Tenn.	63	319
Texas	142	650
Total	703	2876

3.6 Direct and Ratio Estimates for Major Crop Items

Sample data were expanded to estimates by two methods. A direct expansion based on the reciprocal of the sampling rate was applied to all items. For those items on which information was obtained for both 1953 and 1954, a "percent-change indication" was applied to the 1953 Board estimates to derive ratio estimates.

In making these estimates it was necessary to take account of the fact that sample counties were drawn from Farm Type III (Wheat) at about 3 times the sampling rate applied to all other Farm Types. In the direct expansion for any one of these two basic strata, an estimated county total is given by $T_i = t_i/r_i$, where t_i is the sample total for the county and r_i is the within-county sampling rate (fraction of all segments in the county which were enumerated). If n sample counties are drawn from a stratum and N is the number present, an unbiased estimate of the per-county average of the expanded individual county totals is

$$\bar{T} = \frac{T_1/P_1 + T_2/P_2 + - - - + T_n/P_n}{nN},$$

Here P_i is the probability of selection for the i-th county (number of 1950 Census farms in the county divided by the number of 1950 Census farms in the stratum). The expanded estimate for the entire stratum then is

$$N\bar{T} = \frac{T_1/P_1 + T_2/P_2 + - - - + T_n/P_n}{n}$$

In terms of the sample totals for the n individual counties in the sample,

$$N\bar{T} = t_1/(nr_1P_1) + t_2/(nr_2P_2) + - - - + t_n/(nr_nP_n)$$

To get a self-weighted sample of farms, the number of sample segments in each county was set to yield an expectation of 35 Census farms. Therefore, r_i = 35/(Census farms in county). But P_i = (Census farms in county)/(Census farms in stratum). Hence, r_iP_i = 35/(Census farms in stratum), which is obviously constant for all sample counties. For the Type III stratum containing 37,590 Census farms, n = 5 and nr_iP_i = (5)(35)/37,590 = 175/37,590. For the second stratum, containing all other farm types, n = 95 and nr_iP_i = (95)(35)/2,063,422 = 3,325/2,063,422. The expansion factors for the two strata are the reciprocals of those values of nr_iP_i. For the Type III stratum it is 37,590/175 = 214.800. For the second stratum it is 2,063,422/3,325 = 620.578. As these factors are constant for all counties within strata, they could be applied directly to the totals of the sample data for the strata. But there was a small amount of incompleteness in the coverage of the sample in some counties and only a subsample of

eligible farms was interviewed in 2 heavily populated segments. For that reason the factors, with an appropriate adjustment for incompleteness, were applied separately to each sample county. That procedure also makes it more convenient to prepare separate estimates for States or other subregions of the universe if such breakdowns are desired.

The procedure followed was to expand the 2 subsampled congested segments to a 100 percent level before adding the county data. The remaining percentage completeness in the coverage was then computed from information supplied by the interviewers. The expansion factor for the county was then computed by dividing the overall expansion factor given above for the stratum by the relative completeness of the coverage within the county. The sum of the products of the county totals by their corresponding expansion factors was then computed for each item; that sum is the expanded estimate for the 10-State universe.

In this survey sharecroppers were not counted as farm operators, but the number of croppers on the sample farms was tabulated. The estimated number of farms plus the estimated number of croppers should be comparable with the total number of farm operators according to the Census definition. The estimated total farm land should also be comparable to the Census definition. The estimates for these items are shown in table 5 together with current Board estimates.

Table 3.4 - Estimated Numbers of Farms and Acreage of Farm Land

	Survey	Board
Farm Operators (Thous.)	1,710	-----
Croppers (Thous.)	476	-----
Total Farms by Census Definition (Thous.)	2,186	2,123
Farm Land (Thous. acres)	335,611	335,800

The sum of estimated farm operators and croppers, 2,186 thousand, is about 3 percent higher than the current Board estimate of 2,123. This is fairly good agreement, but on closer examination the picture is not as favorable as it appears at first glance. The estimated number of croppers, 476 thousand, seems to be too high. The 1950 Census shows only 317 thousand and there is reason to suspect that there has been a decrease since that date. If some share tenants were erroneously classified as croppers by landlords in the survey, no damage to the other estimates would result, provided that such share tenants were also excluded as farm operators when they were contacted directly by the interviewers. But if such tenants were not excluded when contacted directly by interviewers, they would have a double chance of getting into the sample. The fact that the combined estimate of operators plus croppers does not exceed the Board estimate by an excessive amount suggests that any misclassification of share tenants as croppers did not result in any appreciable overcounting of farms as defined in the Census. Additional support to this view is given by the estimate of farm land which agrees

very closely with the Board figure. However, it will be shown later that the direct expansions of crop acreages and cattle numbers are consistently too high. Overcounting of share-tenant crops and livestock may have been a contributing factor; such over-counting would have a relatively greater effect on crop acreages than on farm land because land operated by such tenants would be cropped intensively. It is also possible that the distribution of area segments was such that a disproportionately large number of farms with sharecroppers was picked up in the sample by chance. This could result in overestimates of crop acreages and some other items without an undue increase in the estimated farm land, although it would seem that the average farm size would be increased also.

For some of the principal crops, farmers were asked to report 1953 data as well as current 1954 data. Such information was asked only of farmers who operated the same land both years or who said they could report for the same land both years, but almost 94 percent of the farmers interviewed fell into that category. The ratios of 1954 to 1953 data were computed for each of the two basic strata and combined by giving the Type III stratum only one-third as much weight as the other. Those ratios were then applied to 1953 Board estimates. Table 3.5 shows the estimates derived from both the direct expansions and the ratios for items which could be estimated by the two methods.

Table 3.5 - Direct and Ratio Expansions Compared with Board Estimates

Item	Direct Expansion Thous. acres	Ratio Estimate Thous. acres	July 1 Board Thous. acres
Corn planted	19,977	17,927	16,441
Cotton planted and to be planted	24,462	18,406	18,320 1/
Cotton already planted	23,928 2/	17,206 2/	17,890 3/
Wheat harvested	9,607	8,087	8,733
Oats harvested for grain	9,431 4/	6,174 4/	5,824
Sorghums planted	13,291	12,710	11,463
Rice harvested	2,075	1,942	1,931
Tobacco planted	1,168	1,071	1,027 5/
Soybeans grown alone	5,312	4,365	2,944
Peanuts picked or threshed	1,746	1,528	1,348 6/
Hay, all	17,082 7/	11,987 7/	9,970
Irish potatoes planted	522	140	144
Sweet potatoes planted	463	315	276
Field Seeds 8/			
Crimson clover	232	112	112
Tall fescue	122	51	54
Lupine	18	137	51
Hairy vetch	431	310	181
White clover	39	30	19
Sweet clover	267	124	56

1/ Administrative use only--not published.
2/ Average date of enumeration about June 10.
3/ Cotton in cultivation July 1.
4/ Includes oats cut ripe and fed unthreshed.
5/ For harvest.
6/ August estimate.
7/ Reported data contain intentions which may not have been realized later.
8/ Estimates based on very few reports.

The ratio estimates are in reasonable agreement with the Board estimates, but the direct expansions are consistently too high.

3.7 Direct Expansions for Other Crop Items

For items having only 1954 data reported, no direct ratios can be computed. But for some of these the ratio estimates given above are still helpful. These items are discussed individually below.

Corn: The direct expansions are,

	Planted Thous. acres	Planted with Hybrid Seed Thous. acres	Farm Stocks Thous. bu.
Survey	19,977	12,334	45,324
Board	16,441	9,227	45,960

It is reasonable to suppose that if the expansion of planted acres is too high, the acreage planted with hybrid seed is correspondingly high. Adjusting to the level of planted acreage from the ratio estimate (17,927 thous.), the corresponding estimate of hybrid acreage would be 11,068,000. But adjusting to the Board level of planted acreage (16,441 thous.) gives an estimated 10,151 thousand acres planted with hybrid, which is also higher than the Board estimate. The Board estimated 56.1 percent of the planted acreage in hybrid while the survey shows 61.7 percent. The estimated stocks are in close agreement with Board estimates as of July 1.

A detailed study was made of the basis on which corn yields are reported by farmers in the 10-State region (See question B-6 on the questionnaire.) For the region as a whole, 92 percent of the growers said they figured their corn production on the basis of ear corn and 8 percent on the basis of shelled corn. The percentage reporting on the basis of shelled corn was very small except in North Carolina and Georgia where the percentages were 24 percent and 13 percent. When these two States are omitted from the computations, the percentage of farms reporting on the basis of shelled corn is only 3 percent.

It was discovered that the practice of reporting yields in terms of barrels rather than bushels was not nearly so extensive as had been supposed. Only about 9 percent of the farms reported in barrels; with the exception of 1 report from Oklahoma, these were all in North Carolina and Tennessee. In those two States 28 percent of the yields were reported in barrels. When barrels were reported on a shelled basis, farmers were consistent in reporting that they considered a barrel to be the equivalent of 5 bushels. But there was considerable variation in their reports of pounds of ear corn per barrel. Those reports ranged between the ridiculous extremes of 50 pounds and 1,500 pounds, but 96 percent of the reports fell in a range of 265-500 pounds. Some of the low reports were undoubtedly vaguely

remembered numbers of pounds per bushel. But others, together with the few unusually high reports, were probably wild guesses. A report that was badly out of line was usually given by a farmer who grew only small amounts of corn and who probably had little conception of standard corn weights. The frequency distribution of reported weights indicates a clustering of reports about each of three modes--one of 350 pounds, one of 370 pounds, and one of 400 pounds.

Farmers reporting in terms of bushels of ear corn were asked for the number of pounds of ear corn in a bushel to determine whether they considered a bushel as (1) a measured bushel (basket) of ears or (2) the quantity of ears that is required to shell out a bushel of shelled corn. The latter is generally about 70 pounds of shucked ears, whereas the former is usually about 35 pounds of shucked ears. Only 3 reports from a total of 1,245 were lower than 45 pounds. These were regarded as representing measured bushels (baskets) of ears. A small number of reports (about 5 percent) fell in the range 45-60 pounds with a mode at 56 pounds. Most of these respondents seem to have misunderstood the question and reported weights of a bushel of shelled corn rather than a bushel of ear corn. The remaining 95 percent of the reports ranged from 70-87 pounds with the modal values differing somewhat from State to State. In Arkansas, Louisiana, Mississippi, Tennessee, Oklahoma, and Texas, there was a clearly identifiable mode at 72 pounds per bushel. In some of these States the officially recognized weight per bushel of ear corn is 72 pounds. In North Carolina the mode fell at 70 pounds and in Georgia at 80 pounds. The high figure for Georgia probably refers to weight of corn in the shuck. North Carolina also shows a small clustering of reported weights at a second mode of 80 pounds, indicating that some of these weights also include the shuck. Alabama shows two modes with most of the reports clustering around 75 pounds and a smaller number clustering around 72 pounds. In South Carolina the major mode is 80 pounds with some reports clustering around a second mode of 72 pounds. These modes are clearly identifiable. Reports that differ much from them were in practically all cases given by farmers who produced only small amounts of corn and probably were not too familiar with standard weights.

The occurrence of several modal values in weight per bushel of ear corn can be explained by the variation in State laws specifying official weights, by variations in moisture content and shelling percentage, and to a certain extent by variations in interviewer influence.

In future surveys in the 10-State region, it seems safe to assume that corn yields reported on a bushel basis are in terms of shelled equivalent (70-80 pounds of ears or 56 pounds of shelled corn) and that reports of barrels may be converted at the rate of 5 bushels to the barrel.

Wheat: The direct expansions are,

	Planted Thous. acres	Harvested Thous. acres	Production Thous. Bu.	Stocks Thous. Bu.
Survey	12,024	9,607	146,471	7,154
Board	11,405	8,733	120,456	1,941

The survey indications of planted acreage and production may be scaled down to the level of the ratio estimate of harvested acreage (8,087 thous.). This gives an estimate of 10,122 thousand acres planted and 123,297 thousand bushels produced. Although the ratio estimate of harvested acreage and the corresponding adjusted estimate of acreage planted are slightly lower than Board estimates, the adjusted production estimate is a trifle higher. The survey yield indication of 15.2 bushels per acre is higher than the Board figure of 13.8 bushels per acre.

The survey estimate of stocks is much above the Board estimate. It may be argued that the survey estimate should be scaled down to the adjusted acreage level, but even such an adjustment would not bring it anywhere near the Board estimate.

Rye: Here only the direct expansions are available.

	Planted Thous. acres	Harvested Thous. acres
Survey	1,489	294
Board	708	220

The Board estimate of planted acreage was made in December 1953 and is less than half of the survey indication. The survey estimate of harvested acreage is not nearly so much out of line, although it exceeds the Board estimate also.

Oats: A ratio estimate of acreage for harvest, which is not much higher than the July 1 Board estimate, is available to adjust the results. The direct expansions and the adjusted figures are shown, together with Board estimates:

	Survey		
	Direct Expansion	Adjusted	Board
Planted (Thous. acres)	12,888	8,446	7,797
Threshed or combined (Thous. acres)	7,059	4,626	-----
Cut ripe & fed unthreshed (Thous. acres)	2,362	1,548	-----
Total harvested for grain (Thous. acres)	9,421	6,174	5,824
Cut green for hay (Thous. acres)	516	338	-----
Production (Thous. bushels)	341,073 1/	210,578 1/	167,618 1/

1/ Includes oats cut ripe and fed unthreshed.

The adjusted survey indications were obtained by multiplying column 1 by 6,174/9,421. This brings the estimated planted and harvested acreages into line

with Board estimates, but the estimated production is still considerably higher than the Board figure. The Board estimate of acreage harvested for grain includes oats cut ripe and fed unthreshed. No separate estimates of the components of that figure, such as were made from the survey data, are made by the Board in its regular operations. The survey indication of yield per acre is 36.2 bushels in contrast to the Board estimate of 28.8 bushels. In arriving at the data on oats cut and fed unthreshed, farmers were asked to report the total amount cut to feed unthreshed, regardless of stage of maturity. They were then asked to report the stage of maturity at which they cut such oats. The replies were used to classify the unthreshed oats into the "ripe" and "green" categories. Of all oats planted 55 percent was threshed or combined, 18 percent was cut and fed unthreshed when ripe, 4 percent was cut and fed green as hay, and 23 percent was not harvested.

Barley: Only the direct expansions are available for comparison with Board estimates.

	Planted Thous. acres	Harvested Thous. acres
Survey	907	813
Board	660	590

Peanuts: The ratio estimate in table 6 is only for peanuts picked or threshed. Total acreages grown alone and interplanted were estimated by direct expansion. But those items may be adjusted to correspond to the level of the ratio estimate for peanuts picked or threshed.

	Grown alone Thous. acres	Interplanted Thous. acres	Picked or Threshed Thous. acres
Survey (Direct expansion)	1,954	291	1,846
Survey (Adjusted)	1,710	255	1,528
Board	1,602	100	1,348 1/

1/ August 1 estimate.

Soybeans: The ratio estimate in table 3.5 is only for soybeans grown alone. But again acreages in other categories estimated by direct expansion may be adjusted to the level of the ratio estimate for soybeans grown alone.

	Grown alone Thous. acres	For beans Thous. acres	For hay Thous. acres	For other purposes Thous. acres	Inter-planted Thous. acres
Survey (Direct expansion)	5,312	4,628	608	76	1,196
Survey (Adjusted)	4,365	3,803	500	62	983
Board	2,944	2,222	---	--	-----

Pasture: Only estimates from the direct expansions are available. These are compared below with 1950 Census data.

	Survey Thous. acres	1950 Census Thous. acres
Open or cleared	82,760	117,968
Woodland	86,117	57,755
Total	168,877	175,723
Improved	27,563	-------
Cut for hay	1,974	-------

The estimated total acreage in pasture agrees fairly well with the Census, but the relative amounts of open or cleared pasture and woodland pasture are considerably different.

Fruits and vegetables: Only results from direct expansions are available. These are compared with 1950 Census data because of the lack of comparable Board estimates.

	Survey Thous. acres	1950 Census Thous. acres
Vegetables and melons	1,240	969
Fruits, vineyards, nuts and berries	963	1,115
Total	2,203	2,084

The survey results are high for vegetables and low for fruits, vineyards, and berries. The aggregate is in reasonable agreement with Census data. It is possible that berry acreages, which are included in the second category by the Census, and which should also have been so reported in the survey, may have been reported with vegetables instead. No detailed breakdown, similar to that in the Census, was obtained in the survey.

3.8 Livestock Estimates

Survey estimates were made only by direct expansion and are compared with available Board data in Table 3.6.

Table 3.6 - Livestock Estimates

Item	June Survey	Board
All cattle (Thous.)	32,159	28,528 1/
Milk cows (Thous.)	5,557	4,795
Percent milked	67	65
Milk per milk cow (Pounds)	12.5	11.0
All hogs and pigs (Thous.)	8,278	10,277 2/
Over 6 months old	2,738	3,467
Sows farrowed, Dec. - June (Thous.)	913	1,024
Pigs saved	5,859	6,810
Pigs per litter	6.42	6.65
Sows to farrow, June - Dec. (Thous.)	1,274	884
All sheep and lambs (Thous.)	4,214	8,209 3/
Ewes 1 year old and older (Thous.)	2,220	4,232 4/
Hens and pullets, laying age (Thous.)	54,860	60,114
Eggs per 100 hens	46.7	54.3

1/ Jan. 1954 estimate, plus Survey estimate of calves born after Jan 1, and minus estimated disappearance of 3,704 thousand. Disappearance estimated from percent of cattle and calves marketed Jan. - June, applied to 1953 marketings shown on balance sheets, plus some allowance for deaths and farm slaughter.

2/ June estimate of hogs over 6 months old, plus pigs saved Dec. 1953 to June 1954.

3/ Jan. 1 estimate, plus lambs saved, less estimated disappearance Jan. - May.

4/ Jan. 1 estimate.

Survey estimates include livestock kept by croppers. But detailed breakdowns were obtained only for livestock kept by farm operators. The survey indicated that 381 thousand head of all cattle were kept by croppers and 221 thousand of these were milk cows. For cattle kept by the farm operators, survey estimates in various categories are as follows:

	Thous. head
Cows and heifers 2 yrs. old and over.	17,566
Heifers and heifer calves less than 2 yrs. old.	7,362
Bulls and steers 1 yr. old and older.	1,907
Bulls and steers less than 1 yr. old.	4,943
Total	31,778

Calf-crop data were also obtained only for farm operators. Survey estimates on those items are:

	Thous. head
Calves born since January 1.	8,163
Calves expected during rest of 1954.	5,858

If allowance were to be made for calves owned by croppers, these figures would have to be increased by about 1 percent.

Survey estimates of all hogs and pigs include an estimated 602 thousand kept by croppers. Estimates for the other categories were derived from data reported only for farm operators, with a proportional adjustment to allow for croppers.

The item on pigs saved was given special attention in the survey. By definition it is intended to refer to total number of live pigs from farrowings. But there has always been some question about whether or not farmers tended to exclude from their reports those pigs which were sold or given away and reared by others. If a farmer disposed of such pigs, he might not consider them "saved." In this survey farmers were asked specifically whether such pigs were included in their reports; when they were not, the number was ascertained and added to the report.

For the 10-State region an estimated 181 thousand such pigs, or 3 percent of the total, were found to be excluded. The percent excluded was greater in some States than in others--Alabama 12 percent, Mississippi 9 percent, and Louisiana 7 percent. No exclusions were found in Arkansas and Oklahoma.

3.9 Sampling Errors

The coefficients of variation, or sampling errors, of the direct expansions of the sample data for major items have been computed by dividing the standard error for each item by the mean for the item. This gives a measure of the

precision, in terms of percent, of the sample with respect to each item. These computations were based upon the between-county variances of sample totals for counties within farm type strata within States.

The sampling error for cotton planted is 14.3 percent. The survey data over expanded by about 34 percent compared with the Board figure. In this case the Board estimate is based on ASC measured acres and should be very close to the true figure. As an estimate should ordinarily differ from the true value by less than twice the sampling error (29 percent in this case) only five times in 100, it appears that a major portion of the overexpansion for cotton is nonsampling error.

Again using cotton as an example, a between-county sampling error of 7 percent is obtained by expanding 1950 Census cotton acres for the 100 counties to a regional total. This would indicate that about 7 of the 14 percent sampling error for cotton is caused by variability within counties. The same relationship undoubtedly holds true for a number of other items. Plans to reduce within-county sampling error in future surveys include enumerating "large farms" in the sample counties, and increasing the number of non-open country segments but enumerating only a fraction of such segments. Direct expansions of the sample, as percents of check data, are compared with the sampling errors for selected items in table 3.7.

Table 3.7 - Direct and Ratio Expansions as Percent of Board Compared with Sampling Errors in June Survey

Item	Unit	Direct Expansion		Ratio Expansion	
		As percent of Board	Sampling error percent	As percent of Board	Sampling error percent
Corn planted	Acres	121.5	8.9	109.0	3.1
Cotton, planted and to be planted 1/	"	133.5	14.3	100.5	2.3
Wheat harvested	"	110.0	28.4	92.6	4.3
Oats harvested for grain 2/	"	161.9	17.4	106.0	6.8
Sorghums planted	"	115.9	22.6	110.9	7.3
Soybeans grown alone	"	180.4	22.1	148.3	11.0
Hay, all 3/	"	171.3	8.0	120.2	3.6
Peanuts picked or threshed 4/	"	129.5	24.2	113.4	10.2
Potatoes planted	"	362.5	59.9	97.2	---
Sweetpotatoes planted	"	167.8	14.0	114.1	---
Tobacco planted 5/	"	113.7	20.4	104.3	2.5
Rice harvested	"	107.5	46.3	100.6	---
All cattle	No.	112.7	11.3	-----	---
Milk cows	"	115.9	8.8	-----	---
Hogs and pigs	"	80.5	13.5	-----	---
Pigs saved	"	86.0	14.0	-----	---
Sheep and lambs	"	53.3	52.3	-----	---
Hens and pullets, laying age	"	91.3	15.6	-----	---

1/ Board estimate not published.
2/ Board estimate includes oats cut ripe and fed unthreshed.
3/ Survey data contain intentions which may not have been realized.
4/ Board estimate for August 1.
5/ Board estimate is tobacco for harvest.

Eliminating causes of over expansions will be the primary concern in future research surveys. Many of the discrepancies in the expansions can be charged to sampling error. But some, such as the 21.5 percent for corn and 33.5 percent for cotton, are too large to be charged entirely to that factor.

The sample apparently contained the correct total number of farms, but too high a proportion of intensively-cropped multiple units. This in itself might be expected to produce an excess of crop acreages. However, analysis of 1950 Census data shows that a simple preponderance of average-type multiple units and croppers would account for an excess of only 2 percent in cropland harvested, 5 percent in corn acreage, and 3 percent in cotton acreage.

The large variance of estimated cotton acreage, and the preponderance of multiple units and croppers in this survey, was caused mainly by a few pockets of large numbers of multiple-unit operators with large cotton acreages. These were mainly in non-open-country segments in Arkansas, Texas, and Oklahoma. Only 3.6 percent of all sample segments covered in the entire 10-State region were in the non-open-country category, but they accounted for 15 percent of all farm operators in the sample, 22 percent of the reported farm land, 25 percent of the croppers, 16 percent of the corn acreage and 18 percent of the cotton acreage.

The large cotton acreages picked up in a few of these segments may have caused a large amount of the overexpansion for the region and also contributed heavily to the estimated variance of the estimate. That situation could be alleviated by spreading the non-open-country portion of the sample over a larger number of such segments, with only portions of each being enumerated, as was already suggested in this report. Introducing a "large-grower" list into the sample design would also help. Such refinements should be effective because studies of Census data indicate that the between-county component of the sampling error in estimated cotton acreage is only about seven percent. This shows that most of the sampling error encountered in the present survey was caused by within-county variability; a few pockets of heavy concentrations of cotton acreages contributed most to this variability.

Most of the discrepancy not explainable as sampling error was probably caused by farmers reporting crop acreages on land that was not included with reported farm land. Particularly for crops grown on shares, an operator may have reported a crop as his own even though the land, by definition, was properly recorded as rented out. Conversely, an operator renting additional land on shares may have reported the crop without reporting the land as rented in. This could be avoided in future surveys by a more careful accounting of the use of all land operated by the farmer and making sure that the sum of reported crop acreages and land not used for crops agrees with the reported farm land. More detailed information on crops grown on shares would also be helpful.

It has been suggested that the area segment itself, rather than the farm, be used as the unit of observation. This would avoid difficulties associated with farm definitions. At present there is not enough evidence to justify abandoning the farm as the unit of observation; there is good reason to believe that the

major difficulties encountered in the present survey can be overcome. However, there are good arguments in favor of initiating studies on "segment inventories" concurrently with farm enumerations as a device for detecting possible biases in the latter.

4. OCTOBER 1 AND DECEMBER 1 CROP PRODUCTION AND LIVESTOCK SURVEYS

4.1 Purpose

The objective of the October survey was to test the feasibility of using mail questionnaires, with nonrespondent follow-ups, to determine the percent of the planted acreage of the major crops remaining for harvest and the yield per harvested acre. For the December 1 survey the primary objective was to test this method of estimating the numbers of livestock on farms by making comparisons with reports from identical farms in June. The October 1 questionnaire also asked for stocks of certain grains. The December 1 schedule repeated the questions on corn and cotton acreage and production, asked for wheat planted for harvest in 1955 and livestock on pasture.

4.2 Summary and Recommendations

Mail surveys, with nonrespondent follow-ups, were made on the entire June sample as of October 1 and December 1 to estimate harvested crop acreages, final crop production and end of year livestock inventories. "Out of pocket" costs were $4600 and absorbed costs $3700 for the 1000 nonrespondents interviewed. Response rates to the first and second mailings were 17 and 20 percent respectively.

The results may be summarized about as follows:

1. This is a satisfactory method of obtaining the percent of planted acreages remaining for harvest.

2. Preharvest estimates of yields by farmers are not a satisfactory basis for forecasting production.

3. Post-harvest reports of yields by farmers are more reliable and may be used to make final estimates of production where objective fruit counts are not made.

4. The percent change in livestock numbers, using December-June identicals, appears to be a satisfactory means of estimating January 1 numbers of cattle and hogs, provided the June levels are correct.

5. Nonrespondent follow-ups should be continued. It would be dangerous to rely solely on mail responses to estimate acres for harvest, yields and livestock numbers.

6. The questionnaires were too long and complicated to get maximum response. Certain data from previous surveys should be entered on the questionnaire to aid the farmer in reporting the current situation.

7. Further exploratory work is necessary to reach any conclusions with respect to the percent of feed livestock are obtaining from pasture and amount of supplemental feeding.

The following recommendations are made with respect to the 1955 research program.

1. Continue the mail surveys with nonrespondent follow-ups.

2. The October 1 survey should be primarily to obtain acreages of crops remaining for harvest and yield per acre, and the December 1 survey should be primarily on livestock numbers.

3. For research purposes the surveys may well be on a subsample of the farms enumerated in June.

4.3 Design of the Sample

Questionnaires were mailed to all eligible farm operators in the June Research Survey. A subsample of about 500 nonrespondents to each survey was interviewed. Segments in which nonrespondents were to be interviewed were selected before the schedules were mailed out by taking all segments with 3,000 acres or more of land in farms and one fourth of the remaining segments which contained eligible farms. If the segments selected for a county had more than 15 farms, a list of 15 names was drawn for interviewing. Nonrespondents to the first mailing of the questionnaire residing in the selected segments, or on the list of names selected, were interviewed during a 2-day period at the end of September. The same procedure was followed at the end of November. In most cases the interviews in each county were made by the person who did the enumeration in June. The interviewers used the same questionnaire as was mailed to the farmers. The object in having the interview work completed in two days was to simulate the conditions one might expect in an operating program of this kind.

4.4 Mail Response

Response to the first mailing was disappointing for both surveys. At least 30 percent of the farmers had been expected to reply but only 17 percent of them returned usable schedules for October 1. The October response ranged from 11 percent in North Carolina and Louisiana to 24 percent in Alabama. The response rates to the first mailing showed a little improvement in December, due perhaps to the October 1 interviews. A second mailing was made to the nonrespondents not selected for interviewing to see if these respondents to the second mailing differed significantly from respondents to the first mailing and interviews.

Table 4.1 Response to Mail Survey

Date	First Mailing		Second Mailing	
	Number	Percent	Number	Percent 1/
Oct. 1	489	17	377	20
Dec. 1	575	20	360	18

1/ Percent response of those receiving second mailing.

Not only was the response low but the quality of the reports left much to be desired. Apparently the questions aimed at determining the size of farm were too complicated to get the right answers. Many of the respondents reported all land owned but failed to deduct land rented out while others reported cropland only or left the spaces blank. Some comparisons of data from the first and second mail returns and interviews are made later in this report.

4.5 October 1 Survey Results

A number of comparisons of the October 1 reports with June reports and Board estimates are made in the following tables. The notation "combined" in a table heading means that the first mail response has been combined with the interview reports expanded to represent all nonrespondents. The sample is too small to make direct expansions for acres planted and acres remaining for harvest. The Survey estimate of the percent of the acres of the various crops remaining for harvest is compared with Board estimates in Table 4.2. This figure may be applied to June planted acres to estimate the acres remaining for harvest. The June planted acres may also be adjusted by making October 1/June identical comparisons. Farmers tend to report the same acreage planted as harvested and to forget about acreages that failed or were plowed up.

Table 4.2 Percent of Planted Acreage Harvested

Crop	1st Mail	2nd Mail	Interview
Cotton	89.3	98.4	98.1
Corn for grain	89.5	84.2	86.7
Wheat for grain	82.1	85.8	86.7
Oats for grain	57.2	62.0	61.8
Barley for grain	78.8	78.0	73.6
Rye for grain	49.8	27.6	38.1
Sorghum for grain	56.7	57.2	46.2
Rice	100.0	100.0	100.0

Table 4.3 Percent of Planted Acreage Harvested Compared with Board

Crop	October 1 Survey "combined" Percent	BOARD Dec. harv./Dec. pl. Percent
Cotton	95.9	95.5
Corn for grain	87.2	84.0
Wheat for grain	85.4	79.5
Oats for grain	61.1	72.6
Barley for grain	74.6	78.3
Rye for grain	39.8	31.1
Sorghum for grain	48.9	56.7
Rice	100.0	98.7

Table 4.4 Ratio of Acres Reported Oct. 1. to Acres Reported in June (Identicals)

Item	1st Mail	Interview	"Combined"
Land in farm (acres)			
owned	100.1	100.1	100.1
rented in	93.7	106.4	104.0
rented out	50.0	83.5	77.2
total	101.4	103.0	102.7
Crops (planted acres)			
cotton	100.3	99.8	99.9
corn	100.0	106.8	105.5
wheat	96.6	97.5	97.3
oats	104.7	85.8	89.4
barley	90.0	147.1	136.3
sorghum	93.8	84.0	85.8

Table 4.5 Acres Planted per Farm, Oct. 1 Survey

	1st Mailing	2nd Mailing	Interviews
cotton	21.2	14.7	11.7
corn	12.9	11.4	11.7
wheat	11.3	8.0	5.7
oats	7.6	8.2	8.3
barley	.6	.6	.5
rye	.8	.4	.7
soybeans for beans	2.9	2.6	2.2
rice	.7	1.8	2.2
sorghum	11.1	5.8	5.0
peanuts for nuts	.7	1.3	1.0
tobacco	.4	.7	.6
potatoes	.5	.2	.3
sweetpotatoes	.2	.2	.2

In most instances yields reported in the October 1 survey are lower than Board estimates for crops where check data are very good (cotton, peanuts, and tobacco) and higher where check data are lacking or incomplete. An exception is rice for which very good check data are available but the Survey sample is extremely small.

If farmers are underestimating the yield per acre of cotton, peanuts and tobacco, it seems reasonable that they may also be underestimating the yield of other crops. Underestimation of yields may be especially pronounced early in the harvest season.

Table 4.6 Yield Per Harvested Acre Indicated in the October 1 Survey Compared With October and December Board Estimate

	Unit	Oct. 1 Survey	Oct. Board	Dec. Board
Cotton	lbs. lint	257	277	292
Corn	bu.	17.9	15.7	16.4
Wheat	"	15.6	13.8	13.6
Oats	"	33.3	28.9	29.7
Barley	"	24.8	20.3	20.4
Rye	"	9.9	9.2	9.3
Soybeans	"	16.2	9.9	11.4
Rice	cwt.	27.1	24.6	24.6
Sorghum	bu.	19.3	17.4	20.4
Peanuts	"	420	624	677
Tobacco	"	1,130	1,301	1,301
Potatoes	"	208	122	124
Sweetpotatoes	"	69	72	75
Hay, all	tons	.86	.83	.92
Lespedeza seed	lbs.	221		133
Tall fescue seed	"	104		188
Crimson clover seed	"	86		131

A direct expansion of the reported stocks on farms to the universe level is unrealistic because of the very small sample. Estimated stocks as a percent of production in the October 1 Survey are compared with October 1 Board stocks as a percent of Board production are given in Table 7.

Table 4.7 Stocks as Percent of Production

Item	Percent of Production	
	October 1 Survey	October 1 Board
Wheat	29.4	21.6
Oats	51.3	58.9
Barley	51.2	54.8
Rye	71.8	60.0
Corn	5.1	5.9

Estimated quantities of these grains remaining on farms as of October 1 from the survey would, of course, differ from the Board estimates to the extent that survey estimates of production multiplied by the percent remaining on farms differs from Board production multiplied by Board percent of stocks on farms.

4.6 December 1 Survey Results

This survey was devoted primarily to livestock numbers and the percent of feed that livestock on pasture were receiving from pasture and the amount of supplemental feeding, if any.

Questions on cotton and corn were repeated and the acreage planted to wheat in the fall of 1954 was obtained. The wheat fields chosen for the 1955 objective yield measurements in Oklahoma and Texas were drawn from the acreage reported in this survey.

Table 4.8 Percent of Planted Acreage Harvested

Crop	Oct. 1 Survey combined percent	Dec. 1 Survey combined percent	Board 1/ Dec. harv./Dec.Pl. percent
Cotton	95.9	90.7 2/	95.5
Corn for grain	87.2	88.0	84.0

1/ It should be pointed out that both the planted and harvested acreage estimates of the Board may be revised in December.

2/ This figure is dominated by one report in the interview follow-up in Texas which showed 800 acres planted and 180 acres harvested. Omitting this report, the remainder shows 99 percent of the planted acreage remaining for harvest.

The December/June identicals showed 87.1 percent as much wheat planted in the fall of 1954 as in 1953. Wheat allotments in 1954 for Oklahoma and Texas, where most of the wheat in the 10-State area is located, are 89.4 percent of the 1953 allotments.

December survey estimates of yield per acre of cotton and corn are closer to the Board estimates than the October Survey. The comparisons are shown in table 4.9.

Table 4.9 December Survey yield per acre for cotton and corn with comparisons

Crop	Unit	Yield per Acre		
		October 1 Survey	December 1 Survey	December Board
Cotton	lbs.	257	303	292
Corn	bu.	17.9	16.3	16.4

The January 1 survey estimates for all cattle were made by applying the "percent change" for the Jan./June identicals to the June survey estimates. The January 1 figures used in this comparison were obtained by adding All Cattle On Farms Now

(Dec. 1) to Calves Expected To Be Born plus Expected Purchases and deducting Expected Sales plus Expected Slaughter in December. A similar procedure was followed in making the January 1 estimates for all hogs. The expected number of pigs to be born in December was obtained by multiplying the number of sows farrowing in December by the average number of pigs per litter.

Table 4.10 Survey Estimates of All Cattle and All Hogs January 1, 1955 Compared with Board

Item	Survey Estimate Thousands	Board Thousands
All Cattle	27,821	23,474
All hogs	8,626	8,435
All Sheep	4,930 1/	6,011

1/ Dec. 1 estimate, data not available to make January 1 estimate.

The percent of all cattle and hogs on farms by classes as of December 1, 1954 is shown below:

Table 4.11 Cattle and Hogs by Classes

	Percent
All Cattle	100.0
Cows & heifers 2 yrs. old and older	60.6
Heifers and heifer calves, under 2 yrs.	23.4
Bulls, bull calves, steers and steer calves of all ages	16.0
All hogs	100.0
Born since June 1, 1954	56.4
Born before June 1, 1954	43.6

Although the number of animal units per farm varies quite widely among the respondents to the 1st and 2nd mailings and the interview, the percent change from June to December 1 among the groups is fairly uniform for major livestock items. These "percent change" comparisons are shown in table 4.12.

Table 4.12 December/June Percent Change in Animal Units per Farm.

Item	1st Mail	2nd Mail	Interview
	Percent Change December/June		
All Cattle and Calves	85.7	87.8	87.4
Cows & Heifers 2 years	95.0	96.2	95.6
Heifers under 2 yrs. & heifer calves	91.1	87.2	90.9
Other cattle	58.1	66.7	63.0
Cows milked	90.0	86.4	92.6
All hogs and pigs	125.5	122.2	119.6
Sows	100.0	100.0	83.3
Hens & pullets laying age	116.6	87.5	46.0 1/

1/ A few big operators went out of business between June and December.

The average weight of fleece reported was 5.60 pounds compared with the Board estimate of 7.86 pounds. However, the sheep growing areas of Texas and Oklahoma where fleece weights are high are not adequately represented in the 100 county sample. The direct expansion of the total number of horses, mules and colts from this small sample is far above the Board estimates and ratio comparisons are not available for these items.

Very little data are available on the amount of feed obtained by livestock from pasture. Some exploratory questions on this subject were included in the December survey. This survey was chosen primarily because it was a livestock survey, even though it is realized that pastures are much more important during other periods of the year.

Apparently these questions asking for numbers of livestock on pasture, percent of feed for such animals coming from that source, and supplemental feeding, if any, were too complex to get satisfactory answers by mail. Less than one half the entries in the section were complete enough to be used in the analysis. Data obtained by interview were much more complete. The sample is too small to expand to actual numbers of livestock on pasture in December.

A summary of the data obtained by first and second mailing and by interview is given below.

Only those reports showingsome portion of the feed coming from pasture were used in these summaries.

Table 4.13 First Mailing, Percent Feed from Pasture and Pounds Supplemental Feeding per Animal

Class Livestock	Number Reports	Feed from pasture	Supplemental feeding pounds per animal		
			silage	hay	grain
		percent			
Milk cows	129	44.5	1.1	11.6	4.9
Other cattle 2 yrs +	103	69.5	.1	4.2	1.0
Other cattle - 2 yrs	108	67.8	1.0	3.8	.8
Horses & mules	63	64.2	---	4.2	2.0
Sheep & Goats	11	49.2		.1	.8
Hogs & pigs 3 mo +	33	44.8	---	---	3.8

Table 4.14 Interviews, Percent Feed From Pasture and Supplemental Feeding Per Animal

Class of Livestock	Number of Reports	Feed from pasture	Supplemental feeding pounds per animal		
			silage	hay	grain
		Percent			
Milk cows	248	48.5	3.9	6.4	7.3
Other cattle 2 yrs +	196	79.1	1.0	2.7	1.4
Other cattle -2 yrs	209	77.2	.3	1.7	1.0
Horses & mules	177	75.2	---	2.7	2.2
Sheep & Goats	20	93.5	---	---	.2
Hogs & pigs 3 mo. +	74	51.4	---	---	2.8

Table 4.15 Second Mailing, Percent Feed From Pasture and Supplemental Feeding

Class of Livestock	Number of Reports	Feed from pasture	Supplemental feeding pounds per animal		
			silage	hay	grain
		Percent			
Milk cows	75	43.3	.1	11.5	6.2
Other cattle 2 yrs +	41	55.0	---	9.6	2.1
Other cattle - 2 yrs.	59	49.8	.4	3.4	1.4
Horses & mules	32	57.9	---	5.0	2.0
Sheep & Goats	4	82.7	---	1.8	---
3 mo. +	19	25.9	---	.1	4.4

The questions should be simplified if the data are to be obtained by mail. The survey should also be made at least quarterly. The importance of pastures in the total feed supply makes further exploratory work in this field highly desirable.

5. Objective Yield Surveys

5.1 Purpose

This phase of the research program is to develop more reliable methods of forecasting and estimating crop yields. The need for accurate information on yields for major crops need not be emphasized. At the present time yield estimates are based on farmers' judgment as to the outturn of the crop. Such a method may not be satisfactory because the farmer may not inspect his crop except when and where convenient or he fails for a variety of other reasons to know or estimate the yield accurately. A method of estimating yields based on plant characteristics, if such can be developed, has the advantage of being more objective and directly reflects the condition of the crop rather than the farmers' judgment of the crop. This phase of the program for fiscal 1954-55 was limited to the 1954 crops of cotton and corn, and the 1955 winter wheat crop. The work on winter wheat will be discussed in a later report summarizing the 1955 crop year studies.

The basic philosophy underlying the surveys for cotton and corn was to obtain and utilize data as of given dates. Three surveys were conducted for each crop, the first was to provide objective plant data and the farmers' yield forecast a month or so before the crop was to be harvested; the second was to obtain plant data for an estimate of yield just prior to the actual harvest by picking small quantities of the crop, and the third to supply data on the amount of the crop left in the field after the farmer had completed his harvesting operations and to get the farmer's report of harvested production.

After the questionnaires were tabulated from the 3000 farm June Survey in the 10 Southern States, two subsamples were drawn consisting of 200 cotton fields and 200 corn fields to be used for those plant observations and other detailed information. Farms and fields were selected with probabilities proportional to the acres planted to each crop as reported in the June survey. Forty of the cotton farms were also selected in the corn sample.

The sample of cotton growers was drawn as the first stage; these were visited during the last week of July to get estimates of acreage for harvest and prospective production, together with counts of bolls, blooms and squares, and data on weevil damage on selected sampling units in randomly selected fields. These data were used to develop a forecasting equation. The same fields and field plots were visited again during the week of August 22 at which time open cotton on the selected sampling units in the sample fields was picked and weighed to provide a preharvest indication of yields. As farm harvesting was completed, the sample farms were visited a third time to get growers' reports of acreages harvested, final production, and data on amount of cotton left behind in the sample fields. This last set of observations was used to reconcile yields estimated from small samples prior to harvest with yields actually obtained under normal harvesting conditions.

A similar program was followed for corn. The first survey was made concurrently with the second cotton survey during the week of August 22. The plant observations consisted of counts and measurements of ears. The second visit took place the week of September 19 when samples of ears were weighed and tested for moisture content to derive a preharvest yield indication. Post-harvest visits, like those for cotton, were made after farmers had harvested the crop.

5.2 Summary and Recommendations

This year's work indicates that the basic objectives and data collected provide a feasible approach to the problem of estimating the yields of cotton and corn by utilizing important plant and fruit characteristics. In the 10 Southern States the timing for cotton and corn surveys should be about the same. This fact would appear to indicate a more efficient use of personnel is possible than was at first believed. The use of grower forecasts or growers' reports of quantities harvested would appear to be of doubtful value in establishing relationships between plant counts and final yields.

The plant data on cotton indicate that for the 10 State area as a whole the crop is sufficiently advanced by September 1 to provide a reliable basis for estimating yield. A large portion of the bolls have reached full size and sufficient cotton is open to determine the average weight per boll by that date. On August 1 the "crop" present is largely in the form of squares, blooms and small bolls. A method of integrating these counts into a reliable forecast of the total bolls for the season is required. Several "models" were developed this year which seem promising and will be used on an experimental basis this coming crop year. The early season forecasts require some assumption to be made concerning the amount of cotton which is missed in picking and the bolls which do not produce cotton. As yet, sufficient data have not been collected on these items to indicate whether the amounts found this year will remain fairly constant from year to year. Any forecasts of yield from these models will require an allowance for harvesting loss or failure of bolls to open. The plot size and plant characteristics used this year are believed to be sufficiently close to operating optimums and will be continued again next year. The following modifications are planned for the coming year's work on cotton:

(1) Increase the number of sample plots taken on each farm.
(2) Use one man sampling teams after the first or August 1 survey.
(3) Tag large bolls, small bolls and blooms to determine the fraction which reach full size and produce cotton.
(4) The seed cotton will be picked on any survey if the field has open bolls ready for picking.
(5) The post-harvest gleaning of a field will be made during the first of the four fixed date surveys in which the field is found to be harvested.
(6) The number of fields should be increased.
(7) The differences between fields on and off roads should be studied so the usefulness of route sampling of fields can be evaluated.

The corn count and measurement data provide a basis for making preharvest yield determinations on October 1. After adjustments are made for harvesting losses, the net yield is about 15 percent higher than the Crop Reporting Board's final yield. The reason for this difference is not clear at this time, but is believed to be the result of one or a combination of the following three factors:

(1) Fields harvested before October 1 for which preharvest corn weights were not available may have had lower yields.
(2) Growers may report harvested yields too low, or on a different basis.

(3) The indicated harvesting losses may be too low due to disappearance of grain between the time of harvest and the time the field gleanings were made.

The data on ear counts and external measurements of the cob provide a basis for estimating the weight of grain to be harvested. The forecast based on the surface area model (discussed later) is in good agreement with the Crop Reporting Board's final yield. The following modifications are planned for the coming year's work.

(1) Start the first survey a month earlier to coincide with the cotton visits.
(2) Increase the total number of fields.
(3) Pick the corn on any of the surveys if the field is mature.
(4) Make the post-harvest gleaning on any of the surveys if the field is found to have been harvested.
(5) The differences between fields on and off roads should be studied so the usefulness of route sampling of fields can be evaluated.
(6) Use one man sampling teams after the first or August 1 survey.

5.3 Cotton Yield Surveys

The farms on which fields were sampled were selected with probability proportional to the acreage planted or to be planted. The farms were selected in the Washington office from the list of farms enumerated on the June Survey. The first step in the selection of farms consisted of computing cumulative total cotton acreage planted or to be planted for all farms enumerated in every State separately for the wheat counties and all other counties, i.e. by strata. The total cotton acreage in each of these groups was 3,970.1 and 37,029.0 respectively. The sampling fraction in the June Survey for the wheat counties was approximately 1/215 and 1/620 for the non-wheat counties. Consequently, a farm in the wheat group had 620/215 or about 2.9 times the probability of being selected as a farm in the non-wheat group. Therefore, the sampling interval in the wheat counties in terms of acreages had to be 2.9 times the sampling interval in the non-wheat counties.

The actual computations were as follows:

Let I be the sampling interval in the non-wheat counties.
and W be the sampling interval in the wheat counties.
where W must equal 2.889066 I.
Then $\frac{3970.1}{W} + \frac{37029.0}{I}$

Substituting 2.889066 I for W, we find

I = 192.02 acres, and W = 554.75 acres.

A random number between 1 and 192 was chosen in the non-wheat counties and another between 1 and 555 in the wheat counties. The cumulative acreage total containing the random number selected the first farm. The second sample farm was selected by adding the sampling interval to the sampling number for the previous farm.

Carrying the above procedure through in all States resulted in a sample of cotton farms selected with probabilities proportional to the reported cotton acreages. If a farm had more than 192 (or 555) acres of cotton, the farm might have been selected more than once. This causes no difficulties because a farm can be used as often as it is selected. The 200 cotton fields were distributed among the 10 States as shown in Table 5.1.

Table 5.1 Number of Sample Cotton Fields by States.

State	Selected	Field Counts Made: Aug. 1	Field Counts Made: Sept. 1	Post-Harvest Gleanings Made
Ala.	12	12	12	7
Ark.	33	27	29	15
Ga.	8	8	8	8
La.	7	7	7	4
Miss.	21	21	21	13
N.C.	3	3	3	1
Okla.	12	12	12	12
Tenn.	9	8	7	7
S.C.	11	11	11	9
Texas	84	77	69	41
10 States	200	186	179	117

August 1 Survey The sample farms chosen were visited in late July. The farmer was interviewed to obtain data on cotton acreage and production. In addition, more detailed information on the sample field(s) was obtained. The selection of sample fields on these farms was accomplished from information obtained in the farm interview. If there was only one cotton field on the farm, there was no problem. But if there were 2 or more, a choice had to be made. The farmer was asked to give his cotton acreage field by field. The sampling team recorded this information as the farmer gave it and computed cumulative totals field by field. The sampling number(s) which selected the farm was also used to select the field. The sampling number(s) had been entered on the schedule in the office before the field work started. The cumulative total which contained the sampling number specified the field in which the observations were to be taken. Each sampling number selected a different field. But if any one field on the farm was larger than the sampling interval, the same field could be selected more than once just as the sample farm itself might have been selected more than once. Table 5.2 below indicates the effect exerted on average farm and field size by selecting farms and fields with probabilities proportional to acres of cotton.

Table 5.2 Acres of Cotton per Farm and Field

Unit & Item	Acres of Cotton Planted or to be Planted
Per Farm:	
All farms in June survey	14
All farms reporting cotton in June Survey	30
Sample farms in yield survey	110
Per Field:	
All fields for farms in yield survey	22
Sample fields in yield survey	38

Farm Interview Data: The farm interview was designed to get specific information concernin the cotton acres planted or to be planted which had been reported in the June acrea e survey. It was also used to select the sample field or fields and to get specific information about each field. In addition, the interview served to tell the farmer about the work to be done in later months. Data relating to the farm unit as a whole are given in Table 5.3 below.

Table 5.3 Interview Data for Farm Unit (August 1)

Item	Unit
1. Yield per acre forecast	270 (± 11.9) pounds of lint
2. June acreage for harvest	92.5 percent
3. Crop harvested to date	3.6 percent

The forecast of yield per acre based on the farm unit (and field) was derived by use of the following estimator:

$$(1)\quad \bar{y} = \frac{480}{n} \sum_{i=1}^{n} \frac{P_i}{A_i}$$

The other two items in Table 5.3 and corresponding items in Table 54 are derived from ratio estimates.

$$(2)\quad R_{\substack{\text{acres}\\ \text{for}\\ \text{harvest}}} = 100 \frac{\sum_{i=1}^{n} A_i}{\sum_{i=1}^{n} A_{pi}}$$

$$(3)\quad R_{\substack{\text{crop harvested}\\ \text{to date}}} = 100 \frac{\sum_{i=1}^{n} P_{hi}}{\sum_{i=1}^{n} P_i}$$

where P_i = expected production in bales on i^{th} farm(field) August 1

P_{hi} = harvested production in bales on i^{th} farm(field) by August 1

A_i = expected acreage for harvest on i^{th} farm August 1

A_{pi} = reported acres planted or to be planted in June for i^{th} farm

480 = pounds of lint in a bale

The Crop Reporting Board's August 1 yield forecast for the same 10 States was 274 pounds of lint per acre. However, it is not known whether growers in the yield survey reported production in terms of net or gross bales. Differences in definition of bales could result in as much as a 4 percent difference in yield. The growers' acreage remaining for harvest is 7.5 percent less than the acreage reported in the June Survey.

As a by product, the farm interview revealed a number of errors in the June acreage data due to faulty enumeration or differences in definitions of the farm unit and in the crop acreages reported for the farm unit. The prime sources of reporting errors due to the definition of the farm unit are believed to be related to the basis upon which allotment crops are assigned to growers and the practice of working crops on shares.

The information given by the farmer on the sample fields is summarized in Table 5.4.

Table 5.4 Interview Data for Sample Fields

1. Initial report of acres of cotton now in field	37.9 acres
2. Average number of acres of cotton now in field less borders, ditches, terraces and other areas not in cotton	37.6 acres
3. Date planted	2/1/54 to 6/18/54
4. Yield per acre	296 (± 13.2) pounds of lint
5. Crop harvested to date	2.0 percent
6. Expected date of final harvest	8/1/54 to 3/1/55

Several items appearing in Tables 5.3 and 5.4 provide interesting comparisons. The yield for the farm unit and the yield for the field as a unit differ more than one would expect. A possible explanation for this difference is that by focusing the grower's attention on the particular field--the date it was planted, the area occupied by the cotton and the fact that counts are to be made--a somewhat independent and perhaps better estimate of yield is obtained. Items 1 and 2 in Table 5.4 indicate the farmer tends to report an acreage figure which he feels is the net acreage of cotton in the field.

Field Plot Observations and Data: Two sampling units or plots were selected in each sample field on which observations were taken. The basic unit consisted of two parallel 10-foot row sections in adjacent rows. The selection was made according to the following rules: Locate the "corner" of the field nearest the most convenient approach to the field, mark this corner with a large wooden stake and proceed to a, b, c, or d (depending on the letter designation following the random sampling number which selected the field).

(a) 1st row in the field and 20 paces down the row.
(b) 10th row in the field and 20 paces down the row.
(c) 20th row in the field and 1 pace down the row.
(d) 20th row in the field and 10 paces down the row.

Locate the second pair of 10-foot row sections by proceeding 20 rows farther into the field and 20 paces farther down the row. In the second field plot an additional 10 feet was measured off on the second row, making this row section 20 feet long. The first unit in each field was designed to measure both border row effects and end of row effects. The second unit was located in an area of the field normally free of such effects. The added 10 feet on the second row of the second unit was designed to provide a comparison of a 10-foot double row unit with a 20 foot single row unit.

The following information was obtained for each 10-feet of row:

1. Counts for entire 10-foot row section
   a. Number of hills
   b. Number of burrs, large open bolls and large unopened bolls
   c. Width across 4 row spaces.
2. Counts for last hill in each 10-foot row section
   a. Number of burrs
   b. Number of large open bolls
   c. Number of large unopened bolls
   d. Number of small bolls
   e. Number of blooms
   f. Number of squares
3. Counts (on plant) for first hill outside each 10-foot row section.
   a, b, c, d, e, and f as in (2).
4. Stripped or picked fruit counts for first hill outside each 10-foot row section.
   a. Number of burrs
   b. Number of large open bolls
   c. Number of large unopened bolls
   d. Number of small bolls

e. Number of small bolls punctured or damaged
f. Number of locks in burrs and large open bolls
g. Number of locks damaged in burrs and large open bolls
h. Number of locks in large unopened bolls
i. Number of locks damaged in large unopened bolls

The counts and data obtained in 1,2,3, and 4 are summarized in Tables 5.5, 5.6, 5.7 and 5.8.

Table 5.5 Average Counts and Row Spacing for 10 ft. of double row units. August 1, 1954

Item	First or Border Unit	Second or Interior Unit	Total for Two Units
(1) Number of hills	18.8	20.6	39.4
(2) Number of burrs, large open bolls, and large unopened bolls	44.3	46.0	90.3
(3) Distance across 4 row spaces(feet)	13.8	13.9	27.7
(4) Total large bolls per hill	2.35	2.24	2.29

Table 5.6 Average Counts by Fruit Categories - Four Hills in Each Field Plot August 1, 1954

Item	First of Border Unit	Second or Interior Unit	Total For Two Units
(1) Number of burrs	0.60	0.46	1.06
(2) Number of large open bolls	1.07	1.28	2.35
(3) Number of large unopened bolls	12.43	10.63	23.06
(4) Total large bolls (1 + 2 + 3)	14.10	12.37	26.47
(5) Number of small bolls	11.46	11.05	22.51
(6) Number of blooms	5.42	5.73	11.15
(7) Number of squares	46.72	45.29	92.01
(8) Total fruit in all categories (1 + 2 + 3 + 5 + 6 + 7)	77.70	74.44	152.14

Table 5.7 Cotton Counts by Hills - 2 Hills Each Unit
August 1, 1954

Type of Count	Large Bolls	Small Bolls	Total Bolls
On the plant only (last hill in each row)	6.2	5.7	11.9
On the plant (First hill beyond 10 ft. row section)	5.8	6.0	11.8
Stripped fruit from plant (First hill beyond 10 ft.) row section)	6.0	6.3	12.3

Table 5.8 Percent of Boll Damage 1/ - Two Hills in Each Unit
August 1, 1954

Category of bolls	First or Border Unit	Second or Interior Unit	Average of Two Units
(1) Lock in burrs, and large open bolls	6.52	4.46	5.65
(2) Locks in large unopened bolls	3.38	4.39	3.83
(3) Locks in all large bolls	3.79	4.44	4.08
(4) Small bolls	6.41	4.91	5.70

1/ Defined as percent of locks damaged for large bolls and percent of bolls damaged for small bolls (damage from all causes).

The data in Table 5.5 indicate the number of large bolls per unit is greater for the interior sections of the field, but this is apparently the result of two factors operating in different directions. Fewer hills per unit were found in the edges of the fields, but this was partially offset by an increase in the number of bolls found per hill. A more detailed account of this difference can be found in the discussion and analysis section. The count of fruit by categories in Table 5.6 indicates the large and small bolls constituted about 3/10 of the total fruit on August 1 while the squares accounted for a major portion or 6/10 of the total fruit present. At such a stage of maturity, the problem of determining what each category will contribute to the actual production is a forecasting problem with many complexities. It is believed that the collection of similar data at various times during the season over several years will lead to realistic and useful forecasting models.

The data in Table 5.7 reveal the difference found by counting the bolls by two different procedures. After boll counts had been made on the plants for the first hill outside of the unit, the samplers traded rows (or units) and picked all fruit on this hill. The data in Table 5.7 show the result of the two counts. In addition, the picked bolls were examined for weevil and other damage, as summarized in Table 5.8. The large bolls were under counted on the plant by 4.5 percent and the small bolls by 4.4 percent. In general, the data suggest that the number of bolls can be counted accurately on the plants except possibly in high yielding fields or for varieties having heavy foliage. While boll weavil damage was considered quite light, a 4-6 percent damage from all causes was found.

The data from the extra 10 feet of row added to the second row in the second field plot were not summarized in Table 5.5. The average number of large bolls per double 10 feet of row was 46.0 compared to 46.2 for the 20 feet of single row. The component of variance between parallel 10 foot sections in adjacent rows was $s^2_p = 127.5$ (bolls squared) while the component between adjacent 10 foot sections in the same row was $s^2_s = 77.8$. These data indicate that 10 feet of double row are a more efficient sampling unit than 20 feet of single row for counts of large bolls on August 1.

September 1 Survey The fields and plots in which counts were made a month earlier were revisited. The sampling team proceeded directly to the sample fields and made the required observations in the same manner as a month earlier, except that seed cotton in the open bolls was picked and weighed. After weighing the seed cotton, a handful from each row section was placed in a moisture-proof bag and carried back to the office. These small samples were weighed en masse at the State Office before the cotton was removed from the bags. The composited samples were spread out to dry at room temperature for a week or so, and reweighed to determine the moisture loss.

In event the field had been harvested, the samplers carried out the post-harvesting gleanings operation and interviewed the grower to obtain the harvested production. Tables 5.9, 5.10, 5.11 and 5.12 summarize the counts and data obtained for the sample fields.

Table 5.9 Average Counts and Weights for 10 ft. of Double Row. September 1, 1954

Item	First or Border Unit	Second or Interior Unit	Total for Two Units
(1) Number of hills	18.0	19.8	37.8
(2) Number of burrs	7.9	8.0	15.9
(3) Number of large open bolls	18.8	18.8	37.6
(4) Number of large unopened bolls	81.3	91.7	173.0
(5) Number of burrs, large open bolls, and large unopened bolls	108.0	118.5	226.5
(6) Weight of seedcotton(grams)	95.7	85.0	190.7
(7) Ratio of air dried weight to field weight			.925

Table 5.10 Average Counts by Fruit Categories - Four Hills in Each Each Field Plot, September 1, 1954

Item	First or Border Unit	Second or Interior Unit	Total for Two Units
(1) Number of burrs	2.1	2.1	4.2
(2) Number of large open bolls	6.1	5.2	11.3
(3) Number of large unopened bolls	25.9	25.2	51.1
(4) Total large bolls (1 + 2 + 3)	34.1	32.5	66.6
(5) Number of small bolls	6.2	5.4	11.6
(6) Number of blooms	1.5	1.1	2.6
(7) Total fruit in all categories (1 + 2 + 3 + 5 + 6)	41.8	39.0	80.8

Table 5.11 Average Boll Counts by Two Methods - Two Hills Each Unit September 1, 1954

Classification of bolls	First or Border Units		Second or Interior Unit	
	Bolls counted on Plant	Bolls Picked	Bolls Counted on Plant	Bolls Picked
(1) Number of burrs	1.1	1.2	1.1	1.1
(2) Number of large open bolls	2.9	2.9	2.8	2.8
(3) Number of large unopened bolls	13.3	13.4	12.6	12.8
(4) Total large bolls (1 + 2 + 3)	17.3	17.5	16.5	16.7
(5) Number of small bolls	3.1	3.2	2.8	3.1
(6) Number of large and small bolls (1 + 2 + 3 + 5)	20.4	20.7	19.3	19.8

Table 5.12 Percent of Boll Damage 1/ - Two Hills in Each Unit
September 1, 1954

Classification of bolls	First or Border Unit	Second or Interior Unit	Average of Two Units
(1) Locks in burrs and large open bolls	6.3	7.2	6.7
(2) Locks in large unopened bolls	5.2	6.0	5.6
(3) Total locks in large bolls	5.4	6.3	5.8
(4) Small bolls	16.6	15.7	16.1

1/Defined as percent of locks damaged for large bolls and percent of bolls damaged for small bolls (i.e., damage from all causes).

Tables 5.5 and 5.9 indicate that from August 1 to September 1 the number of large bolls per field increased from 90.3 to 226.5. The interior plots averaged more bolls per unit than the border plots but, unlike the August 1 data, the number of bolls per hill is about the same for both interior and border plots. However, there is a decrease in the number of hills per unit. The reason for such a decrease is not clear, but errors in counting or possibly "thinning" due to natural or mechanical means may be responsible. The data in Table 5.10 indicate most of the bolls are nearing maturity, with small bolls and blooms contributing only a relatively small amount to the total count. It is believed that the fruit counted on September 1 accounts for all fruit that will contribute to the crop in most areas. The large bolls were under counted by only 1.4 percent in contrast to approximately 4.5 percent on August 1. However, the small bolls were undercounted by 7.5 percent as compared to 4.4 percent on August 1. The damage found in large bolls increased slightly from 4.1 percent to 5.8 percent whereas damage to small bolls showed a marked increase since August 1 from 5.7 percent to 16.1 percent.

Post-Harvest Survey: This survey was not tied to any specific Crop Report date. The sample farms were visited after final production data were available and gleanings could be made in the sample fields. Two new field plots, located several rows farther into the field, were selected in each sample field for the gleaning operation. These plots were in areas of the field which had been harvested by the farmer. In addition, the location of each sample field was sketched so it could be delineated on aerial photos in the county ASC offices for acreage comparisons. When the field could not be identified on the aerial photos, no acreage comparison between ASC measurements and farmers' reported data was attempted.

Farm Interview Data: The farm interview was used to obtain final production data for the farm as a whole, together with more detailed information for the sample field(s). In a few instances it was impossible to get final production data for all farms in a given locality at the time of the post-harvest trips and before the

cutoff date of January 31, 1955. However, for those farms where some of the crop was still to be picked, reports were obtained on cotton harvested to date and additional bales expected. The interview data for the farm unit is summarized in Table 5.13.

Table 5.13 Interview Data for Farm Unit (Post-Harvest)

Item	Unit
1. Yield per acre	252 (± 10.8) pounds of lint
2. June acreage harvested	91.4 percent
3. Crop harvested to date	97.4 percent

These statistics are derived from estimators similar to 1, 2, and 3 used for Table 5.3. The Crop Reporting Board's December 1 estimate for the 10 States was 292 pounds of lint per acre.

While the Board's December 1 yield figure shows a marked increase over the August 1 forecast, the growers' reported post-harvest yield is lower than their August 1 forecast. As acreage and ginnings are known accurately the growers apparently reported production or acreage incorrectly. The percent of the June acreage harvested is 91.4, or 1 percent below the indicated acreage for harvest given on August 1.

The information given by the farmers for the sample fields is summarized in Table 5.14.

Table 5.14 Interview Data for Sample Fields (Post-Harvest)

Item	Unit
1. Yield per acre	267 (± 10.8) pounds of lint
2. Crop harvested to date	97.6 percent
3. Method of harvesting fields	175 Number reporting
a. Hand picked or snapped	165 " "
b. Machine stripped or shredded	18 " "
c. Machine picked	15 " "
(1) Hand gleaned behind machine picker	4 " "
4. Date harvest completed (or will be completed)	After 8/1/54 100 percent
	9/1/54 93.9 "
	10/1/54 55.3 "
	12/1/54 20.3 "
	1/1/55 3.1 "

Items (1) and (2) are also similar to those used before.

Field Gleaning Data: A different pair of field plots was laid out in the area already harvested by the farmer. Observations were taken on double 10 foot row sections as before, except that the new units were located 2 rows farther into the field . Separate counts were made for bolls found on the plants and on the ground (i.e. the "middles" associated with the rows). All seedcotton was placed in a bag and taken to the State office where it was air dried and its weight determined. These data are summarized in Table 5.15.

Table 5.15 Average Counts and Weights for Two Field Units (Post-Harvest)

Item	On Plants	On Ground	Field Total
Number of burrs	121.1	18.8	139.9
Number of open bolls	11.0	10.5	21.5
Number of unopen or dried bolls	15.6	8.4	24.0
Grams of air dried seed cotton found (113 Fields)			51.4

The number of burrs in Table 5.15 undoubtedly represents an underestimate of the number of bolls from which seed cotton was picked. Some of the burrs were missing because of natural dropping or because dried burrs were knocked from the plant in harvesting.

In gleaning operations 51.4 grams of seed cotton were found in open bolls or loose on the ground. The unopened and dried bolls did not produce any cotton. If unopened and dried bolls are assumed to yield the same amount of cotton per boll as the open bolls, the total losses per field would be (21.5 + 24.0) (51.4 / 21.5)-108.8 grams for the sampling units or about 74.8 pounds of seed cotton per acre. In the past, harvesting losses have been found to be proportional to yields, consequently the open, unopened and dried bolls were plotted against the September 1 large bolls. The post-harvest counts were found to be roughly proportional to the September 1 counts. If the harvesting loss is assumed to be proportional to yield, as represented by large bolls counted September 1, the harvesting loss would be 70.0 pound per acre after adjusting to the level of the large bolls for all fields used in the September 1 yield estimate. However, the 74.8 pounds of seed cotton per acre was used as the harvesting loss for computing the net yield. The proportionality of harvesting losses to yields was studied to determine the validity of such an assumption since, early in the season before the harvesting losses are known, it will be necessary to make some assumption about harvesting losses. Table 5.16 summarizes the reasons gleanings could not be made in certain fields.

Table 5.16 Reason Post-Harvest Gleanings were Not Made

Reason	Number Fields
Plowed or Destroyed	40
Grazed	15
Harvest Not Completed	12
Unable to Make Observations	8
Total	75

Acreage Verification Data: A verification of the acreage figure for each of the sample fields was undertaken. However, it was not possible to identify all sample fields on photos because the ASC delineation of fields differed from our definition. In all crop estimating procedures the problem of definitions is a fundamental consideration. In the objective yield work acreage verification was important for several reasons: (1) to determine whether farmers report acreage accurately, (2) what is included or excluded in the farmers report, and (3) to determine whether growers' reported acreage data may account for differences if present, between subjective and objective yield estimates.

Each sample field was spotted on the county highway map and a sketch of the field and its boundaries prepared at the time of the Post-Harvest Survey. In addition, the crop of land use of fields adjoining the sample field was noted. Later the county ASC office was visited and the aerial photograph which included the sample field was examined. The following information was obtained in the ASC county office.

(1) Can the field be identified on the photograph?
(2) Are the boundaries on the photo the same as for the sample field?
(3) Date this field was last measured.
(4) Method of determining acreage.
(5) ASC latest measured acres.
(6) Does this area (5) include blank areas along field boundaries, ditches etc.?

If the field had not been measured, a planimetered or rotometered acreage determination was requested or obtained. Table 5.17 shows comparisons between farmers' reported acreage and measured acreage for fields whose boundaries were the same as identified on the aerial photos.

Table 5.17 Comparison of Farmers Reported Acreages and Objective Acreage Determinations - 129 Fields
(Post-Harvest)

Survey & Item	Total Acres	Percent of (6)
August 1 Survey		
(1) Acres planted	5166.7	102.2
(2) Acres now standing	5126.0	101.4
(3) Acres now standing less ditches etc.	5083.4	100.6
Post Harvest Survey		
(4) Acres planted	5045.2	99.8
(5) Acres harvested	4958.2	98.1
(6) ASC or Aerial Photo Measurement	5053.6	100.0

Table 5.18 shows the acreage for all fields identified on the phots regardless of whether there was agreement between boundaries on the photo and the field sketch.

Table 5.18 Comparison of Farmers' August 1 Reported Acreages and Objective Acreage Determination - 161 Fields

Survey and Item	Total Acres	Percent of (4)
August 1 Survey		
(1) Acres planted	6304.9	103.3
(2) Acres now standing	6165.7	101.0
(3) Acres now standing less ditches, etc.	6119.5	100.3
Post-Harvest		
(4) ASC or Aerial Photo Measurement.	6103.1	100.0

An examination of these data suggests that there may be several verifiable acreage concepts. It is necessary to remember that verification, objective or otherwise, cannot be absolute. One can only show that the observations are com-

patible with assumptions. From Table 5.17 it is clear that the net acreage reported by growers (item 3) at the time of the August 1 Survey and the planted acreage reported on the Post-Harvest Survey come quite close to corresponding to the ASC or Aerial Photo Measurements for the fields. This suggests that when the grower has the unit or field clearly in mind his reported cotton acreage can be relied upon. The question of exactly what his definition of acreage includes or excludes still requires some speculation. From what is know about ASC and current farm practices, the farmer's definition of planted acres is apparently equivalent to the acres of land seeded, or the cultivated area of the field excluding ditches, fences, terraces or any other sizeable areas which were not seeded or fairly large areas on which cotton is no longer standing. This definition of acreage would appear suitable for use with objective yield estimates where the field plots are permitted by chance to fall only in occasional barren spaces, or areas void of plants within the border rows and end plants. While the current practice of reporting cotton acreages appears to be satisfactory for use with objective yield estimates, a change in the procedure of determining acreage allotments or the lifting of controls may alter the growers' concept of acreage.

5.4 Corn Yield Surveys

The farms on which fields were sampled were selected with probabilities proportional to the acreage planted or to be planted. The Washington office made the selection from the list of farms enumerated in the June Survey. The acreages of corn planted or to be planted were cummulated farm by farm separately for the Wheat counties and all other counties. The total reported corn acreage in each of these groups was 447 and 31461 respectively. The original sampling fraction was approximately 1/215 in the wheat stratum and 1/620 in the non-wheat stratum. As for cotton, the sampling interval in the wheat stratum in terms of acreages, had to be about 2.9 times the sampling interval in the non-wheat counties.

The computations were

$$\frac{447}{W} + \frac{31461.0}{I} = 200$$

where $W = 2.889066\ I$

The sampling interval is W = 456.7 for the wheat counties and I = 158.08 for the non wheat counties.

A random number between 1 and 158 in the non-wheat stratum and 1 and 457 in the wheat stratum was chosen as the starting point. The cumulative acreage total containing the random number selected the first farm. The second sample farm was selected by adding the sampling interval to the sampling number for the previous farm. This procedure of adding the sampling interval to the number which selected the preceding farm was used to select the third, fourth, and remaining farms. The 200 corn fields were distributed among the 10 States as shown in Table 5.19.

Table 5.19 Number of Sample Corn Fields by States

State	Selected	Field Counts Made: Sept. 1	Field Counts Made: Oct. 1	Post-Harvest Gleanings Made
Ala.	24	22	21	9
Ark.	13	8	8	3
Ga.	34	32	27	6
La.	8	7	6	1
Miss.	21	16	16	2
N.C.	25	21	19	7
Okla.	3	2	0	3
Tenn.	24	22	23	10
S.C.	22	22	20	18
Texas	26	11	4	3
10 States	200	163	144	62

September 1 Survey The selected farms were visited in late August by the same sampling teams that made the September 1 cotton counts. The farmer was interviewed

to obtain data on corn acreage and production for the farm. In addition, more detailed information for the sample field(s) was obtained. The selection of sample fields on these farms was carried out as for cotton fields, except that only acres of corn for grain were sampled. In the event that the sampling number was greater than the cumulated acres for grain, the sampling number was divided by 2 and a new number obtained. Table 5.20 indicates the effect exerted on the average per unit of selecting farms and fields with probabilities proportional to the number of acres of corn.

Table 5.20 Acres of Corn per Farm and Field

Unit & Item	Acres of Corn Planted or to be Planted
Per farm:	
All farms in June Survey	11.3
All farms reporting corn in June Survey	17.9
Sample farms in Yield Survey	57.9
Per Field:	
All fields for farms in Yield Survey	11.1*
Sample fields for farms in Yield Survey	16.9*

* Acres for Grain

Farm Interview Data: The interview was designed to get specific information on acres of corn for grain and the amount expected to be harvested. It was also used to select the sample field or fields and to get specific information about each field. In addition, the interview served to tell the farmer about the work to be done in later months and requested him to keep an accurate account of the production for the sample field. The data relating to the farm as a unit are given below.

Table 5.21 Interview Data for Farm Unit (Sept. 1)

Item	Unit
1. Yield per acre	19.8 (-1.02) bushels
2. June acreage for harvest	91.6 percent
Use of acres to be harvested	
For grain	83.7 percent
For silage	4.4 "
Hogged off, cut for green or dry forage	11.9 "
3. Crop harvested to date	10.2 "

The yield per acre for the farm unit was derived by use of the following estimator:

$$(1)\quad \bar{\bar{y}} = \frac{1}{n}\sum_{i=1}^{n}\frac{P_i}{A_i} \quad \text{bushels per acre}$$

The other items in the table and corresponding items in Table 5.22 are derived from ratio estimates.

$$2R_{\text{acres for harvest}} = 100\,\frac{\sum_{i=1}^{n} A_{hi}}{\sum_{i=1}^{n} A_{pi}} \text{ percent}$$

$$R_{\text{acres for grain}} = 100\,\frac{\sum_{i=1}^{n} A_{gi}}{\sum_{i=1}^{n} A_{hi}} \text{ percent}$$

$$R_{\text{acres for silage}} = 100\,\frac{\sum_{i=1}^{n} A_{si}}{\sum_{i=1}^{n} A_{hi}} \text{ percent}$$

$$R_{\text{acres hogged off}} = 100\,\frac{\sum_{i=1}^{n2} A_{di}}{\sum_{i=1}^{n} A_{hi}} \text{ percent}$$

$$(3)\qquad R_{\substack{\text{crop harvested}\\ \text{to date}}} = 100\,\frac{\sum_{i=1}^{n} P_{hi}}{\sum_{i=1}^{n} P_i} \text{ percent}$$

where P_i = bushels harvested and to be harvested on i^{th} farm (field) Sept. 1

P_{hi} = bushels harvested on i^{th} farm (field) by Sept. 1

A_{Pi} = acres planted or to be planted on i^{th} farm in June

A_{hi} = acres for harvest on i^{th} farm Sept. 1

A_{gi} = acres for grain on i^{th} farm Sept. 1

A_{si} = acres for silage on i^{th} farm Sept. 1

A_{di} = acres hogged off on i^{th} farm Sept. 1

The Crop Reporting Board's yield per acre for the September 1 forecast date in the 10 States was 16.0 bushels.

The information given by the growers for the sample fields is summarized in Table 5.22.

Table 5.22 Interview Data for Sample Fields

Item	Unit
1. Acres of corn planted in field	16.9 acres
2. Acres for grain less borders ditches, and areas not in corn	16.7 acres
3. Date planted	2/14/54 to 6/17/54
4. Yield per acre	19.5 bushels
5. Fields harvested to date	11.0 percent
6. Expected date of harvest	7/15/54 to 12/15/54

Field Plot Observations and Data: In each sample field two plots were selected each consisting of two parallel 15-foot row sections in adjacent rows. The selection was made according to the same procedure as for cotton, namely, locate the "corner" of the field nearest the most convenient approach to the field, mark this corner with a large wooden stake and proceed to a, b, c, or d (depending on the letter designation following the random number which selected the field). The a, b, c, and d locations within the fields were the same as described for cotton.

The following information was obtained for each 15-feet or row.

1. Counts for entire 15-foot row section
   a. Number of stalks.
   b. Number of stalks with ears.
   c. Number of ears.
   d. Width across 4 row spaces.
2. Counts for 15 foot section in Row 2, Plot 2.
   a. Number of ears
   b. Number of ears not expected to produce grain.
   c. Length of cob for each ear (determined in husk).
   d. Diameter of cob for each ear (determined in husk).
3. Determinations for first 5 ears beyond Row 2, Plot 2.
   a. Percent fill for each ear.
   b. Stage of maturity for each ear.

The counts and data obtained in 1, 2, and 3 are summarized in Tables 5.23, 5.24, and 5.25.

Table 5.23 Average counts and Row Spacing for 15 feet of Double Row. September 1, 1954

Item	First or Border Unit	Second or Interior Unit	Total for Two Units
(1) Number of stalks	13.2	13.8	27.0
(2) Number of stalks with ears	10.6	11.4	22.0
(3) Number of ears	13.1	13.8	26.9
(4) Width across 4 row spaces (feet)	13.7	13.8	----

Table 5.24 Average Counts and Ears Measurements for Row 2 of Plot 2 September 1, 1954

Item	Average
(1) Number of ears	6.96
(2) Length of ear in husk (inches)	5.93
(3) Diameter of ear in husk (inches)	1.75
(4) Number of ears not expected to make grain	.66
length of ear in husk (inches)	2.78
diameter of ear in husk (inches)	1.16

Table 5.25 Percent Fill and Stage of Maturity for 5 ears beyond Row 2, Plot 2 September 1, 1954

Item	Percent
(1) Area of cob filled with grain	68.30
(2) Stage of maturity for ears	
Mature	51.0
Dent	25.2
Dough	8.3
Milk	8.4
Earlier Milk	7.1

The stalk and ear counts in Table 5.23 for the interior sections of the field average 4-5 percent greater than for the border units. The counts indicate about 1.2 ears per stalk. However, the proportion of ears not expected to make grain, determined as a subjective estimate on the part of the samplers, is about 10 percent as indicated in Table 5.24. The data on cob measurements indicate these ears are much smaller than the average for all ears. These facts together suggest that in most cases the second ear on a stalk could not be expected to contribute very much to the yield.

In Table 5.25 the 68.3 percent fill indicates that the yield will be considerable less than could be expected from the same number of ears under more favorable crop conditions. The maturity date indicates about three fourths (51.0 + 25.2) of the ears were mature enough for a preharvest sample on that date.

The data summarized in Table 5.24 are expected to provide a basis for forecasting yields prior to actual harvesting by relating the ear measurements to the weight of corn picked. In addition, it is hoped that these data will make

it necessary actually to harvest(i.e. pick and weigh)only a small amount of corn in each field.

October 1 Survey: In late September the sampling teams revisited the same fields and plots which were staked out a month earlier. The grower was not contacted unless the field was already harvested. The stalk and ear counts made a month earlier were repeated. In addition, the corn was picked and weighed. Two ears from each field were selected and placed in moisture proof bags for moisture determinations and individual ear data. These ears were selected from the second row in each unit. As the ears were husked, an ear count was made until the fifth ear was reached. This ear was tagged with a rubber band and placed in a moisture proof bag after the weight of all the corn in the row was determined. The count started with the lower ear on the first field unit and with the upper ear on second unit in each field if there was more than one ear to a stalk. In the event the field had been harvested, the samplers carried out the post-harvest gleaning procedure and interviewed the grower. Tables 5.26 and 5.27 summarize the data obtained in those fields where preharvest samples were obtained.

Table 5.26 Counts and Weights for 15 feet of Double Row Plot
October 1, 1954

Item	First or Border Units	Second or Interior Unit	Total of Two Units
(1) Number of stalks	13.1	13.8	26.9
(2) Number of stalks with ears	9.8	10.4	20.2
(3) Number of ears	11.8	12.4	24.2
(4) Weight of ear corn (lbs)	3.56	3.85	7.41

Table 5.27 Weights and Measurements for 2 Ears in Each Field

Item	Unit
(1) Length of ear	5.78 inches
(2) Diameter of ear	1.58 inches
(3) Weight of ear corn	118.3 grams
(4) Weight of grain	92.8 grams
(5) Moisture Content of grain	16.7 percent
(6) Area of cob filled with grain	77 percent
(7) Stage of maturity of ears	
Mature	89.7 percent
Dent	9.3 Percent
Dough	1.0 percent
Milk	0 percent

An October 1 yield estimate was computed from the weight of ear corn, shelling percentage and moisture content. The yield per acre in bushels of shelled corn is:

$$\text{Bu. shelled corn} = \frac{(\text{lbs of ear corn in 60 ft.})(\text{Shelling Percent})(\text{Sq.ft.in acre})}{(60)(\text{Row width in ft.})(\text{lbs in bushels})}$$

$$= \frac{(7.4078)(.7893)(43560)}{(60)(3.44012)(56)} = \frac{254,771}{11,558}$$

$$= 22.0$$

The yield, adjusted to a moisture content of 15.5 percent is 21.3. The sampling error of this estimate is 1.4 bushels or 6.7 percent. A net or adjusted yield was computed after the post harvest gleanings were obtained. It was tentatively assumed that the harvesting loss would be of the order of 10 percent based on previous experience; thus a yield per acre of 19.2 bushels was to be expected.

Post-Harvest Survey: The sample farms were to be visited after final production data were available. This survey was not tied to any specific date, but was to coincide with the harvest as closely as possible. Two new plots, located several rows farther into the field, were selected in each sample field for the gleaning operation. These plots were in areas of the field which had been harvested by the farmer. The location of each sample field was also sketched so it could be delineated on aerial photos in the county ASC offices for acreage comparisons. In event the field could not be identified on the aerial photos, no acreage comparison between ASC or photo measurements and farmers' reported data was attempted.

Farm Interview Data: The interview was designed to get actual production for the farm and somewhat more detailed information on the sample field. In instances where it was not possible to get final production data for all farms in a given locality before the cutoff date of January 31, 1955, a report was obtained on the bushels harvested to date and the additional bushels expected. The interview data for the farm are summarized in Table 5.28.

Table 5.28 Interview Data for Farm Unit (Post-Harvest)

Item	Unit
1. Yield per acre	16.3 (-1.00) bus.
2. Sept. 1 acres for grain which were harvested	98.2 percent
3. Crop harvested to date	91.9 percent

The Crop Reporting Board's December 1 estimate for the 10 States was 16.4 bushels per acre. While the Board's December 1 yield figure shows an increase over the September 1 forecast, the growers post-harvest yield is considerable lower (3 bushels) than their September 1 forecast. The growers actually harvested about 1.8 percent less acres for grain they they indicated on September 1.

The information for the sample fields is summarized in Table 5.29.

Table 5.29 Interview Data for Sample Fields (Post-Harvest)

Item	Unit
1. Yield per acre	17.0 (± 1.09) bushels
2. September 1 acres harvested	99.2 percent
3. Crop harvested to date	97.6 percent
4. Method of Harvesting fields	137 Reports
a. Hand picked	111
b. Machine picked	26
5. Fields grazed by livestock since harvest	50.0 percent
6. Ears picked for feed prior to harvest	0.13 bushels per acre
7. Date harvest completed (or will be completed)	after 9/1/54 89 percent
	10/1/54 79 percent
	11/1/54 31 percent
	12/1/54 5 percent

Field Gleaning Data: The observations were taken on two 15-foot double row plots in the area harvested by the farmer. These plots were located two rows farther into the field than those used earlier. The number of ears, weight of ears, and weight of grain, were determined separately for the plants and the "middle" associated with each row. These data are summarized in Table 5.30.

Table 5.30 Average Counts and Weights for Two Field Units (Post-Harvest)

Item	On Plants	On Ground	Field Total
Number of ears	3.7	1.7	5.4
Weight of ears (grams)	170.7	144.6	315.3
Weight of grain from ears (grams)	127.6	89.7	209.0
Weight of loose kernals (grams)	------	22.2	22.2
Total weight of all grain (grams)	127.6	111.9	239.5

The data in Table 5.30 suggest that the ears still on the stalk were considerably smaller or poorly developed since the weight of grain per ear is 34.5 grams as compared to 52.8 grams for ears found on the ground. Both of these averages are considerably less than that found on the October 1 Survey. The extent to which grain may have been consumed by animals is not known. The contribution of loose kernals to the total weight of grain is quite small. This is probably to be expected where corn is picked by hand. The harvesting loss per acre is:

$$\text{Bushels per acre} = \frac{(\text{Weight of Grain in Grams})(\text{Sq.ft. in Acre})}{(\text{Length of Row})(\text{Row width})(\text{Pounds in bushel})(\text{Grams in pound})}$$

$$\text{Bushels per acre} = \frac{(239.452)(43560)}{(60)(3.44012)(56)(453.59)} = 1.99$$

However, the 1.99 bushels per acre is probably an underestimate, as growers indicated some of the fields had been grazed by livestock. When these fields were dropped from the analysis, the harvesting loss indicated for the remaining fields was 2.25 bushels per acre. Table 5.31 summarizes the reasons gleanings could not be made on a number of fields.

Table 5.31 Reason Post-Harvest Gleanings Were Not Made

Reason	Number of Fields
Plowed or Destroyed	5
Hogged or Grazed	44
Harvest not completed	14
No observations made	41
Total	104

Acreage Verification Data: The same acreage verification procedure that was followed for cotton was also used for corn fields. Table 5.32 shows comparisons between farmers' reported acreage and acreage measurements for fields whose boundaries were the same as identified on the aerial photos.

Table 5.32 Comparison of Farmers Reported Acreage and Objective Acreage Determination--102 Fields, (Post-Harvest)

Survey	Total Acres	Percent of ASC or Photo Measurements
Sept. 1 Survey		
(1) Acres planted	1605.5	107.4
(2) Acres for harvest	1604.5	107.3
(3) Acres for grain less ditches, etc.	1590.7	106.4
Post-Harvest Survey		
(4) Acres planted	1541	103.1
(5) Acres for harvest	1530	102.3
(6) ASC or aerial photo measurement	1495.1	100

In the case of cotton the data indicated that where the grower had the unit or field clearly in mind his reported acreage was in agreement with the measurement data, even though he tended to reduce his acreage as the season progressed. The reported corn acreage decreased between the two surveys by more than can be accounted for by abandonment. The reported acres for harvest appear to be on a somewhat different basis than the ASC or aerial photo measurements. It seems likely that the growers tend to report the gross acres within field boundaries rather than the area actually planted to corn. If this is the case, a downward adjustment in the yield per acre obtained from objective yield surveys should be made for the difference in the acreage concept.

5.5 Discussion and Analysis of Yield Data

Cotton: The August 1 cotton survey was to provide data for establishing a yield forecast prior to harvest time. The data, when correlated with the actual outturn of the crop, provide a basis for developing a regression equation which can be used in forecasting yields. Regression coefficients from such equations frequently exhibit significant year to year changes even though the correlation within years may be quite high. Consequently, the forecasting of yields by this means may require an accumulation of experience over several years before satisfactory forecasts can be made. In general, the large bolls present on September 1 are believed largely to account for the total yield actually harvested. It is believed that a yield forecast based on a forecast of the number of large bolls to be formed and an assumed weight per boll of about 4.5 grams of seed cotton, would give a satisfactory forecast of yield per acre. Therefore, the August 1 counts were correlated with the September 1 large bolls counted on 4 identical hills (2 hills per unit) in each field with the object of developing an equation for estimating large bolls on September 1. This relationship is expressed by the following equation:

Regression Model $Y_i = b_o + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + b_4X_{4i} + E_i$

where Y_i = large bolls counted Sept. 1 on i^{th} unit.

X_{1i} = large bolls counted August 1 on i^{th} unit.

X_{2i} = small bolls counted August 1 on i^{th} unit.

X_{3i} = blooms counted August 1 on i^{th} unit.

X_{4i} = squares counted August 1 on i^{th} unit.

E_i = a random error component with mean zero.

b's = the net regression coefficients.

These data yield the following equation and results:

$$Y = 1.503 + .888X_1 + .0773X_2 + .2540X_3 + .3795X_4$$

$$R^2_{y.1234} = .743 \qquad S_E = 7.83 \text{ bolls}$$

The standard errors of the regression coefficients are: $S_{b_1} = .0501$, $S_{b_2} = .0893$, $S_{b_3} = .1878$ and $S_{b_4} = .0237$. The regression coefficients for small bolls and blooms are not significant. These coefficients would seem to

indicate that small bolls and blooms can be expected to make relatively fewer large bolls than do squares. In general, this would appear contrary to fact. However, as these two factors are probably very highly correlated with large bolls or squares on August 1, their inclusion in the forecasting equation does not improve the forecast of large bolls September 1. A more logical assumption would seem to be that small bolls and blooms have a greater chance of making large bolls than do squares. These data would seem to indicate that this assumption is not justified or that unusual weather and other environmental factors were controlling last year. The same types of regression equations were computed separately for the "middle" and "late" maturing belts. These analyses indicate about the same situation with regard to small bolls, blooms and squares.

This year's work, plus past failures of the regression type models to forecast accurately between years, suggests that alternative models should be investigated. An approach that might tend to overcome deficiencies in the regression model may be based on the plant characteristics themselves at particular points in time. Two "capacity models" were postulated and are given below. The first model is based upon the assumption referred to in the preceding paragraph. That is, a small boll has a greater chance of making a large boll than does a square. In addition, the basic assumption made for both of these "capacity models" is that the boll load, represented by the total fruit counted, has been established by August 1. The chance of survival (due to competition between classes of fruit) for any of the counted small bolls, blooms or squares is assumed to be equal to the attained age of each class of fruit divided by length of time required for a square or bud to reach full size.

Information available on the growth of fruiting parts indicates about 21 days are required for a square to reach the blooming stage, the blooms being present for no more than 2 days, and another 21 days for a small boll to reach full size. However, another 30 days usually transpire before the boll is cracked or begins to open. From previous research, the chance of a bloom reaching full size is believed to be about .50 or less. The model is as follows:

$$Y_i = C_1X_{1i} + C_2X_{2i} + C_3X_{3i} + C_4X_{4i} + E_i$$

Where $C_1 = 44/44 = 1$

$C_2 = 33.5/44 = .761$

$C_3 = 22/44 = .500$

$C_4 = 10.5/44 = .239$

E_i = a random error component with mean zero.

The C_i are derived by assuming that the age of all fruit in a group can be represented by the mid-point of the age group and that the C_i will remain constant from year to year. However, the possible effects of unusually heavy weevil or any other insect damage if such damage were to occur, are not re-

flected in the C_i. This model may be expected to underestimate the bolls reaching full size in late maturing fields where the plant "capacity" may not be established by August 1, or the C_i's may not reflect the competitive situation when all classes of fruit have not had time to develop.

This model was "tested" by correlating the September 1 count of large bolls with the computed Y_i for two hills in each unit from the August 1 data. These data give

$$Y(\text{Sept. 1}) = X_1 + .761X_2 + .500X3 + .239X_3$$

$$R^2 = .681 \qquad \text{and } S_E = 8.67 \text{ bolls}$$

This model gives a forecast of the number of full size bolls per 40 feet of row as 232.4 as compared to 226.5 counted on September 1. A more refined relationship between the age of the fruit and the chance of survival can probably be developed by taking into account the age distribution field by field, rather than using the simpler assumption that the chance of survival for all fruit in a category for the 10 States can be represented by the same C_i. The hill data were classified into groups on the basis of whether or not any large bolls were counted on the August 1 date. If no large bolls were counted, it was assumed that competitive conditions would be more nearly reflected by basing the C_i on the average age for the group divided by the maximum age for the fruit present: $C_2 = \frac{33.5}{43.0}$ or .779, $C_3 = \frac{22}{43.0}$ or .512 and $C_4 = \frac{10.5}{43.0}$ or .244. If no large or small bolls were counted in a field (i.e., on the 4 hills) the C_i would be $C_3 = \frac{22}{23}$ or .957 and $C_4 = \frac{10.5}{23}$ or .457. In the event that no large bolls, small bolls, or blooms were found by August 1, $C_4 = \frac{10.5}{21.0}$ or .50. That is, the early fruit set is more likely to make large bolls or be replaced by other fruit which will make cotton. While it is fairly evident that these refinements can not materially improve upon the R^2 of .681, since $R^2 = .743$ for the multiple regression solution, a more logical forecasting equation may be obtained for the late maturing fields. The Y_i were computed from the August 1 data with the fields classified into these groups. The resulting R^2 is .680 and gives the forecast of the number of full size bolls per 40 feet of row as 249.4. If the boll weight and row spacings are assumed to be the same as those used in previous computations, a yield indication of 286 pounds of lint per acre is obtained. This is the estimate given in Table 5.33 under the column headed sample plots for August 1.

A model could also be based on a probability density function which would follow a typical growth curve. One such curve was determined by assuming the

rate of change of survival with age to be represented by the equation:

$$\frac{dP}{dR} = KR(1 - R)$$

where $R = \frac{\text{attained age of fruit (or X days)}}{\text{time required to reach full size (44 days)}}$

and K = constant.

The probability density function is

$$P = \frac{KR^2}{2} - \frac{KR^3}{3} + C.$$

K and C were determined by assuming P = 1 for X = 44 and P = .02 for X = 0. This last assumption is somewhat arbitrary. However, the slope of the typical growth curve changes very slowly at either extreme. The probability for a new bud surviving is certainly greater than zero, a value of P = .02 may be reasonable since R = .0227 for X = 1. The resulting value of K is not greatly influenced by minor variations in the choice of P_0. The derived probability function under the assumption that all classes of fruit are competitive is:

$$P = 2.94\ R^2 - 1.96\ R3 + .02$$

The computed probabilities for X = 10.5, 22, and 33.5 are .161, .510, and .859 respectively, as compared to .239, .500 and .761 in "Capacity Model I". Such refinements in the basic probabilities will be tested later as additional data are secured in future surveys which will bear more directly on this point.

The September 1 survey was to provide data for an objective yield estimate from the boll counts and weights of seed cotton in open bolls. A distinction between preharvest surveys for other crops and the September 1 cotton survey should be noted. In most preharvest surveys fruit which may not always be completely mature (for example grain or ears of corn) is picked and the weight per sampling unit determined. In the September cotton survey the seed cotton picked was actually from mature bolls. The importance of this difference in preharvest surveys is not known, but it should reduce possible biases which may be associated with the harvesting of an immature crop.

A yield indication based on the number of large bolls counted and the average weight of seed cotton per open boll was computed from the September 1 survey data. The yield of seed cotton for this estimate is given by:

$$\text{lbs of seed cotton per acre} = \frac{(\text{lge. bolls per 40 ft.})(\text{wt. in grams per open boll})(\text{Sq. ft. in acre})}{(40)(\text{Row width in ft.})(\text{Grams in 1 lb})}$$

$$\frac{(226.564)(4.99325)(43560)}{(40)(3.45464)(453.592)} = 786.2$$

If the lint in a pound of seed cotton is assumed to be .37 of a pound, the yield of lint per acre is 290.9 pounds. A net or adjusted yield was derived after making

allowances for conversion of field weights to a dried weight (7.5 percent less), under counting of bolls(2.3 percent), harvesting losses (74.8 pounds of seed cotton per acre), and correcting the average boll counts (3.7%) by giving the border units and interior units proper weight. In addition, an allowance of 34 bolls per 40 feet of row was made for small bolls and blooms maturing after September 1 by use of "Capacity Model I" described in connection with the August 1 data. The net or adjusted yield computed from Capacity Model I is:

lbs of seed cotton per acre = 805.1

which corresponds to 297.9 pounds of lint per acre.

It should be noted that no allowance was made for damage other than that reflected in the weight of the seed cotton picked per boll. The sampling error resulting from sampling errors in the September 1 large boll count, weight of seed cotton, and row spacing is 6.1 percent or 18.2 pounds of lint per acre.

A second model was derived from the Board's Dec. 1 yield and the counts made in the August 1, September 1, and Post Harvest Surveys. The assumption used in setting up this model is that the contribution of each class of fruit to the final production can be derived from the equations:

$$(1)\quad X_1 + a_1Z_1 - bX_1 = X_2$$

$$(2)\quad Y_1 + a_2Z_1 + bX_1 = Y_2$$

$$(3)\quad Y_2 + bX_2 = Y_F$$

where in (1)

X_1 = Small bolls and blooms counted August 1

Z_1 = Squares counted August 1

X_2 = Small bolls and blooms counted Sept. 1

and in (2)

Y_1 = Large bolls counted August 1

Y_2 = Large bolls counted September 1

X_1 = Small bolls and blooms counted August 1

Z_1 = Squares counted August 1

and in (3)

Y_2 = Large bolls counted September 1

Y_F = Total large bolls and dried bolls produced or present at harvest.

X_2 = Small bolls and blooms counted September 1.

The numerical value of Y_F may be derived from the Board Dec. 1 yield per acre and the post harvest counts of large open and unopened bolls, and dried bolls. The Board yield is converted to bolls producing cotton by assuming 1 pound of seed cotton per 100 bolls and 37 pounds of lint per 100 pounds of seed cotton and adding the large open, large unopened bolls and dried up bolls found on the post-harvest survey.

Equation (1) assumes the small bolls and blooms present on August 1, plus the fraction a_1 of the squares, less the fraction b of the small bolls and blooms, will equal the small bolls and blooms present September 1. Equation (2) assumes the large bolls present August 1 plus the fraction a_2 of the squares, plus the fraction b of the small bolls August 1 (same as for (1)) will account for the large bolls present on September 1. Equation (3) says the large bolls present September 1 plus the fraction b of the small bolls and blooms, will account for the total bolls picked and on the plants after harvest. The survey counts indicate that b = 1.0, a_1 = .1541 and a_2 = .0675. The August 1 forecast of bolls picked and on the plant at the end of the season is

$$Y_F = (a_1 + a_2)Z_1 + bX_1 + Y_1$$

or $$Y_F = .2216\ Z_1 + X_1 + Y_1 .$$

The September 1 forecast is:

$$Y_F = b\,X_2 + Y_2$$

or

$$Y_F = X_2 + Y_2 .$$

Since the survey counts and Board Dec. 1 yield were used to derive a_1, a_2, and b for these models, the forecasts agree perfectly with the Board's December 1 estimate of 292 pounds of lint per acre. A test of the validity of the coefficients requires additional data from another year's work.

A comparison of various yield indications is given in Table 5.33.

Table 5.33 Comparison of Yield from Objective Yield Survey and Crop Reporting Board Estimates

(pounds of lint per acre)

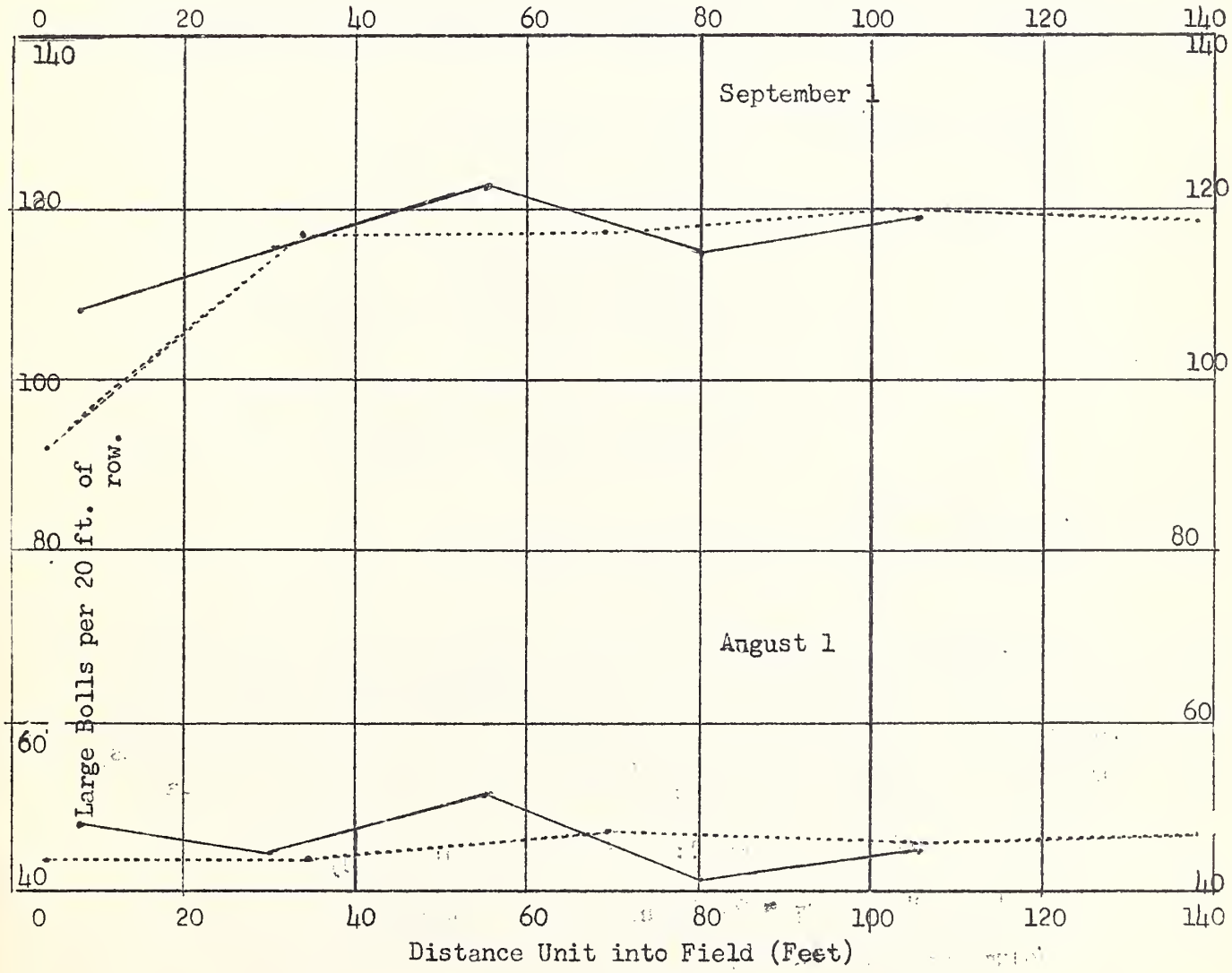
Date	Yield Surveys			Crop Reporting Board
	Growers' Estimate For Farm	Growers' Estimate For Fields	Sample Plots	
August 1	270	296	286	274
Sept. 1			298	251
Oct. 1				277
Nov. 1				282
Dec. 1	252	267		292

The growers' yield estimates on August 1 are in closer agreement with the Board's December 1 yield than the growers' Post-Harvest yields. For both yield surveys the growers' estimate for the sample fields is greater than for the farm as a whole. The reason for this difference is not clear, but possibly a more careful estimate was made for the sample fields. This would seem to be logical if a grower has a large acreage of cotton, and he is asked to speculate on the outturn of the crop without taking care to study each of the fields. His per-farm estimate, in such cases, may be a long-time average or norm which would tend to be too low in good years and too high in poor years. The coefficient of variability computed from the growers' yield estimates is only 59 percent, while the coefficient of variability computed from the objective yield data for the sample fields is 102 percent. This suggests that growers tend to report yields which are less variable than they should be. The objective yield estimate for September 1 agrees remarkably well with the Board's December 1 yield. This result, and the fact that the growers' yield estimate after harvest does not agree more closely with the Board's Estimate, suggests the need for a more careful look at the non-sampling errors which may be associated with growers' reported yields.

A comparison of the border rows and ends of fields with the interior of the fields indicates no effects that can be detected in the August 1 large boll counts. However, the September counts indicate a smaller yield for the border areas of the field. The reason the border units do not indicate any effects on August 1 is perhaps surprising; however, the reduction in yield in the border units may be the result of bolls being knocked off by equipment as the season progressed or by plants not being able to carry the heavier set of bolls found. Apparently a 40-foot strip around the edge of the field may have a smaller yield than the interior section of the field. For a 35 acre field this is approximately 12.5 percent of the total field area.

Chart 5.1: Number of Large Bolls per Field Plot by Distance from Crop Borders

..... rows from edge
_____ paces. from edge



Corn: The September 1 corn survey was designed to provide a basis for forecasting yield prior to harvest time. The development of useful relationships between plant characteristic and the yield or weight of ear corn at maturity seemed a desirable approach. The extent to which year to year variations in these relationships may play a part is not known, but it is believed possible to develop forecasting techniques which are valid from year to year. The simplest approach which suggests itself is a relationship between the number of ears counted and the weight of corn harvested. While this approach is simple and has the advantage that ears are formed sufficiently in advance of harvest so they provide a means of forecasting yield, the weight of grain per ear, or the size of ear, may be subject to significant year to year changes. Consequently, a method which would take these factors into consideration would be preferable. A yield forecasting model was formulated which relates the outer surface area of an ear or ears to the weight of ear corn without actually harvesting the corn on September 1. Another model would be one relating ear volume to weight of ear corn. These models are expressed by the following relationships.

Surface Area Model: $W_i = b_o + b(\pi \cdot L_i \cdot D_i) + E_i$

Where W_i = weight of ear corn (tenths of pounds)

π = constant (3.1416)

L_i = External length of cob (inches)

D_i = External diameter of ear (inches)

E_i = a random error component with mean zero

The second model would be:

Volume Model: $W_i = c_o + c_1\left(\frac{\pi}{4} \cdot L_i \cdot D_i^2\right) + E_i$

The b's and c's are net regression coefficients. The weights and other data used are on a 15 feet of row basis. That is, the surface area or volume of all ears in 15 ft. of row on September 1 is correlated with the weight of the ear corn picked for the 15 ft. of row on October 1. To simplify the computations, the constants π, $\frac{\pi}{4}$ and $\frac{\pi}{4}$ were omitted in making the calculations. The data yield the following equations and results:

Surface Area Model: $W = 8.99 + .0144 (L \cdot D)$

where $R^2 = .69$ $S_E = 9.42$ and $S_C = .000845$

Volume Model: $W = 13.9 + .0351 (L \cdot D^2)$

where $R^2 = .53$ $S_E = 11.5$ and $S_C = .00286$

While both models may be satisfactory as forecasting techniques, an inspection of the data indicates that the Surface Area Model gives a better relationship. The plotted data indicate both models are non-linear near the origin. The reason for this is not entirely clear but it would seem likely that the cob length may be fairly well established before most of the dry matter in the kernels is laid down.

The introduction of additional characteristics would seem desireable since the crop may be in different stages of maturity or the weight of grain or cob area covered by kernels may vary depending on the season. Therefore, a somewhat more refined model was formulated.

A model based on the surface area covered by kernels, i.e. "producing surface", was set up for two maturity classes as follows:

$$\text{Producing Surface Model } W_i = b_o + b_1(L_i \cdot D_i \cdot F_i) + E_i$$

where all the symbols have the same meaning as before except F, which is the percent of cob covered by kernels (i.e. percent fill). The data yield the following results:

Producing Surface Model for Fields in Dent or Ripe Stage:

$$W = 10.08 + .0156\ (L \cdot D \cdot F)$$

$$R^2 = .73 \quad S_E = 7.77 \quad \text{and } S_b = .00102.$$

Producing Surface Model for Fields in Milk or Dough Stage

$$W = 21.55 + .0134\ (L \cdot D \cdot F)$$

$$R^2 = .58 \quad S_E = 12.64 \quad \text{and } S_b = .00365$$

The graphs of the weights and producing surface data indicated the relationships were non-linear in the neighborhood of the origin (i.e. for very low yielding plots or fields the weight of ear corn per unit of producing area was greater than for high yielding fields or plots). A model relating to the "effective or producing volume" was studied for these same two maturity classes. These are given below:

Volume Model for Fields in Dent or Ripe Stage:

$$W = 13.8 + .0399\ (L \cdot D^2)$$

$$R^2 = .56 \quad S_E = 9.88 \quad \text{and } S_b = .00373$$

Volume Model for Fields in Milk or Dough Stage

$$W = 16.6 + .0277\ (L \cdot D^2)$$

$R^2 = .43$ $S_E = 14.9$ and $S_b = .00542$

It is expected that yield forecasts as of fixed dates may have to be made by maturity groups since the earliness or lateness of the crop may vary sufficiently to invalidate other types of relationships.

The October 1 survey data were to provide a pre-harvest yield estimate based on the weight of corn on the sample plots. The gross yield indicated was 21.3 bushels of shelled corn at 15.5 percent moisture, from which a harvesting loss of 1.99 bushels per acre needs to be deducted to arrive at a net yield of 19.3 bushels of shelled corn per acre. The two sample ears used for determining the moisture and shelling percentages were also measured to determine the relationship of volume or surface area of shucked ears to weight of ear corn and grain. The September 1 relationships were based on the totals for 15 feet of row. The producing surface model used for the September 1 date was applied to the two sample ears selected in each field. These October 1 data yield the following results for the weight of ear corn in tenths of pounds.

Producing Surface Model: $W = - .4801 + .01925 (L.D.F)$

$R^2 = .83$ $S_E = .134$ and $S_b = .000682$

The same model was used to relate the producing surface to the weight of grain (or kernels) for the two sample ears. These data yield the following results.

Producing Surface Model: $W = - .5309 + .01558 (L.D.F)$

$R^2 = .86$ $S_E = .103$ $S_b = .000528$

The graph of the plotted data on the weight of grain and the producing surface (grain surface for mature ears) does not indicate a non-linear relationship near the origin as when the models related to weight of ear corn. However, the graph does indicate a slight tendency to be concave upward. When the weight of ear corn and surface or volume were plotted on logarithmic paper for the models studied, the relationships were linear. A comparison of the various yield indications is given in Table 5.34.

Table 5.34: Comparison of Yield from Objective Yield Survey and Crop Reporting Board Estimates (bushels of shelled corn per acre)

Date	Yield Survey 1/			Crop Reporting Board 2/
	Growers Estimate: For Farm	Growers Estimate: For Fields	Sample Plots	
Sept. 1	19.8	19.5	16.6	16.0
Oct. 1			19.3	15.7
Nov. 1				15.8
Dec. 1	16.3	17.0		16.4

1/ Yield for grain.
2/ Yield for all purposes.

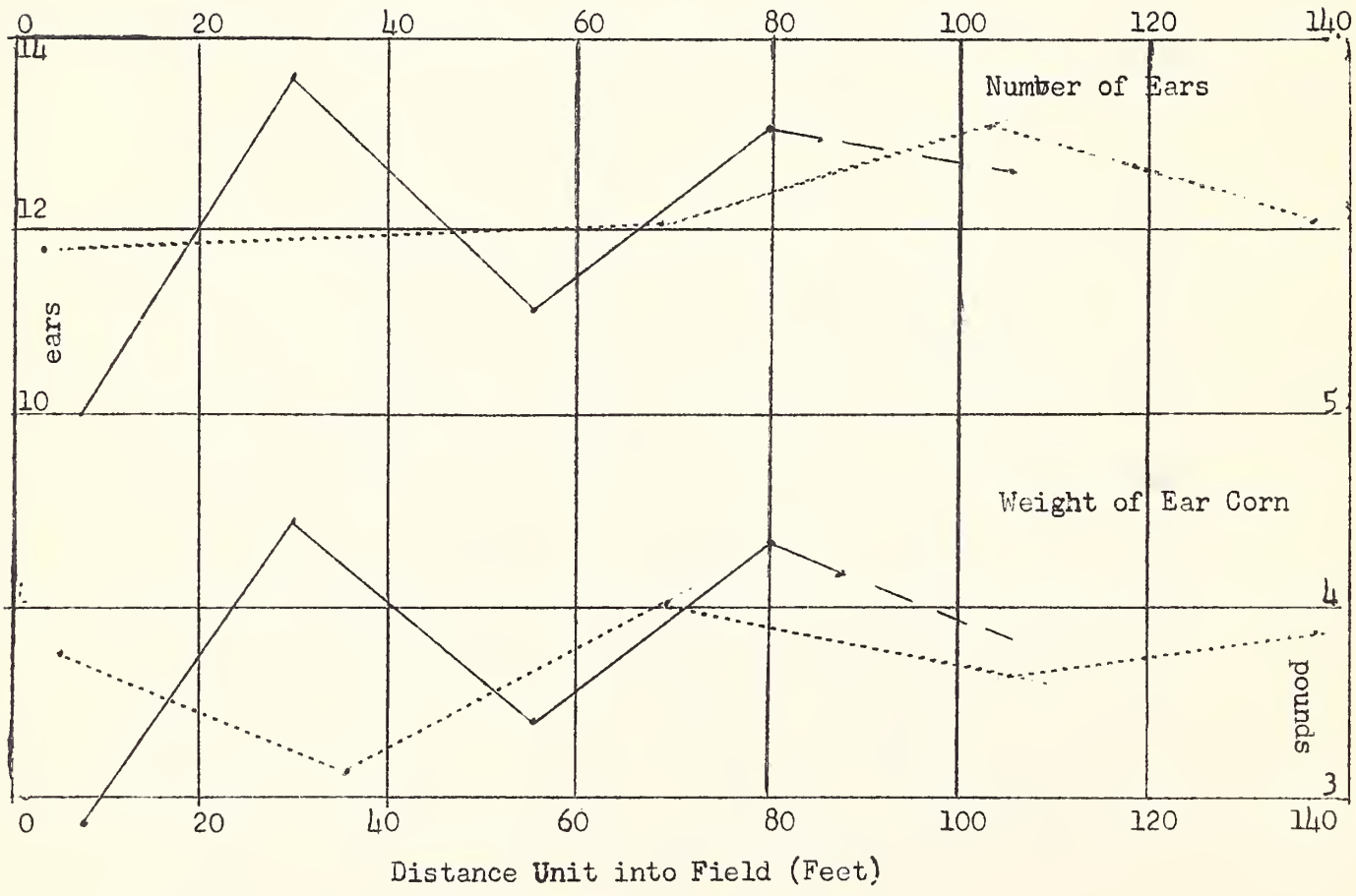
The growers' yield estimates on September 1 are considerable above their December 1 yields (Post-Harvest). It is believed the growers' final yields for the sample fields are greater than the per-farm yield because of the probing on various uses of corn prior to the main harvest, which the farmers may fail to include in their production estimates. The surface area model was used to derive a September 1 forecast of yield. This yield is considerably lower than the October 1 pre-harvest yield estimate based on weight of ear corn per sample plot. It would appear this difference is the result of lower yields on fields which were harvested between September 1 and October 1 than on fields not harvested by October 1. The growers' final yields are in close agreement with the Board's December 1 yield per acre.

A comparison of the border rows and ends of fields is shown in Chart 5.2. Both the ears counted and weight of ear corn show a small but irregular increase for the interior locations in the field. The ear counts for September 1 show a pattern similar to the October 1 count. However, no adjustment was made in the pre-harvest estimate of yield per acre for border effects as for cotton.

Chart 5.2: Number of Ears and Weight of Corn per Field Plot by Distance from Crop Border

..... Rows from edge

—— Paces from edge



5.6 Analysis of Variance Tables.

The analyses of variance for selected items are given in Tables 5.35 to 5.39. They indicate that only one plot or sampling unit should be taken per field. However, the variability between plots within fields is no doubt less than would be found if random units had been selected in the fields; as both units came from the same section of the field, the units are closer together than random units. Nevertheless, it may be expected that with further experience an analysis would indicate that more fields should be taken with only one plot per field. However, when costs are brought into the picture the data indicates that the second unit in the field increases per field costs by on 5-7 percent while the variance is reduced by about 8 percent. The between fields within States variance component was used to compute the sampling error for the surveys.

Table 5.35 Analysis of Variance for Large Bolls for 10 feet of Row August 1

Source of Variability	D. F.	S. S.	M. S.
Total	744	1,040,971	
Mean (22.57)	1	379,310	
Adjusted Total	743	661,661	890.5
States	9	129,661	14,408.0
Fields within States	176	424,232	2,410.4
Plots within Fields	186	58,166	312.7
Rows within Plots	372	49,602	133.3

Table 5.36 Analysis of Variance for Large Bolls for 10 ft. of Row September 1

Source of Variability	D.F.	S.S.	M.S.
Total	716	3,394,719	
Mean(56.64)	1	2,297,078	
Adjusted Total	715	1,097,641	1535.2
States	9	456,684	50.743
Fields within States	169	372,874	2,206.4
Plots within Fields	179	129,883	725.4
Rows within Plots	358	138,200	386.0

Table 5.37 Number of Ears of Corn for 15 feet of Row
September 1

Source of Variability	D. F.	S. S.	M. S.
Total	668	41,761	
Mean (6.72)	1	30,220.1	
Adjusted Total	667	11,540.9	17.30
States	9	1,842.1	204.68
Fields within States	157	6,453.0	41.10
Plots within Fields	167	1,588.3	9.51
Rows within Plots	334	1,657.5	4.96

Table 5.38 Number of ears of Corn for 15 feet of Row
October 1

Source of Variability	D.F.	S. S.	M. S.
Total	568	30,338.0	
Mean (6.05)	1	20,785.4	
Adjusted Total	567	9,552.6	16.85
States	9	1,700.9	188.99
Fields within States	132	5,478.2	41.50
Plots within Fields	142	1,133.5	7.98
Rows within Plots	284	1,240	4.37

Table 5.39 Weight of Ear Corn for 15 feet of Row
October 1

Source of Variability	D. F.	S. S.	M. S.
Total	564	3,816.8	
Mean (1.85)	1	1,934.4	
Adjusted Total	563	1,882.4	3.34
States	9	396.2	44.02
Fields within States	131	1,124.2	8.58
Plots within Fields	141	149.4	1.06
Rows within Plots	282	212.6	0.75

6. Summary of Projects at Statistical Laboratories

In addition to the surveys conducted by AMS personnel, a project on corn production was contracted to the Iowa State College Statistical Laboratory and a project on cotton production was contracted to the North Carolina State College Statistical Laboratory. The general task of these two projects was to investigate the technique leading to improved methods of determining acreage, yield and production through the use of objective methods not directly dependent upon the farmers' judgment. Only a summary of the results of the two projects is contained in this report; a detailed account of these projects is to be found in the final reports from these two institutions.

6.1 Corn Project at Iowa State College

The general purpose of this project was the investigation of techniques leading to improved methods of collecting and utilizing information for the estimation of corn production. The forecast problem was considered directly only with respect to estimates made after the date when the corn crop presumably reaches its maximum dry weight content.

The objectives were:

(1) To determine what concepts and definitions regarding yield and acreage are presently in use by farmers;
(2) To compare questionnaire methods with objective measurement techniques as two means of determining corn yield and acreage; and
(3) To investigate problems relating to the design of samples for estimating crop yield and acreage.

These objectives suggest that the concepts involved in estimating production must be clearly defined. Preliminary work in the 1952 and the 1953 Corn Production Study indicate that there is considerable vagueness in what "yield" and "acreage" of a crop actually are. With respect to corn acreage, several possible "acreages" may be considered: the acreage planted; the acreage which produced a crop; the acreage likely to be harvested, as given at any pre-harvest date; the acreage actually harvested. The yield or production concepts are equally ambiguous and are further obscured by the lack of any standard unit of measurement. Present reports are usually made in terms of a bushel of corn at a certain percent moisture, but it is doubtful if the farmers furnishing the basic information follow any established rule. Therefore, it is of special interest to compare the responses obtained from farmers regarding the yields and acreages of corn on their farms with direct determinations of these quantities through measurements on their farms.

Methods of Study--Two sample surveys of Iowa farms were made in C. R. Districts 2, 5, and 8 after the maximum dry matter content of corn had been attained. The first survey was in mid-September and the second survey just before harvest time or about mid-October. Starting on the first of September, an investigation of when the maximum dry matter content of corn is laid down was also undertaken by a series of weekly field visits. In addition, a post-harvest survey to measure the volume of corn cribs (and bins) was included with the gleaning phase (unpicked ears and kernels) of the operations. Finally, acreage measurements were made on a subsample of the farms selected for this study for comparison with farmers' acreage figures.

The first survey in mid-September was made on the 200 selected farms. The selection of farms was made by strata; two Public Land Survey sections were drawn at random from each stratum and a point was chosen at random on aerial photographs of the selected sections. The sampling operation resulted in a stratified sample with unequal probabilities of selection of farms within the strata. An interview questionnaire was used to obtain farm acreages

and estimates of production, and to explore certain concepts by referring to the 1953 corn harvest. On each of the 200 farms objective corn measurements were made. Three segments consisting of two-row strips 25 feet long were chosen at random on each of the 200 farms. Within a segment a sample of ears was weighed and 2 ears were selected for moisture and shelling percentage determinations. The length and circumference of each ear in this sample was also noted.

The second farm survey repeated questions on the farmers' estimates of production and acreage to be harvested. Several questions were included to probe the matter of production somewhat further. Farmers were asked what moisture content they anticipated at harvest time and how they take account of corn left in the field. Objective measurements were made in the same manner as for Survey I except that only a subsample of about 66 farms was used.

In order to achieve a valid estimate of production and to compare objective measurement with questionnaire information, a post-harvest gleaning on about 50 of the 200 farms was carried out to estimate the amount of corn left in the fields. It consisted of picking up and weighing all grain and ears left on the ground and any corn left on the stalks on selected plots.

An investigation of when the dry matter content of the corn is laid down was also undertaken. Each ear of corn on a segment three rows wide and 25 feet long was tagged on about September 1 on 24 farms in C. R. District 5. Weekly revisits to these segments were made to take length and circumference measurements on these ears. Each week two ears from each segment were selected to be sent back to the laboratory for dry matter content analyses.

The final phase of the field operation consisted of two-man teams visiting about 50 sample farms to take actual field measurements of the acreage of field corn harvested for grain. These acreage determinations were compared with the corresponding questionnaire answers.

Results of Study: It was apparent from the comparison of the farmers' reported acres intended for harvest and the net acres for grain, obtained by probing deeper on field acreages, that an overestimate of the true net acres intended for harvest is usually given. The extent of the overstatement was 2.2 percent. The data suggest that irregular shaped fields are less apt to be overstated. There did not appear to be any significant difference -- on the average -- between the farmers' net acres obtained by probing on wasteland, fence lines, etc., and the measured acres obtained by two men using a steel surveyors' tape.

The production of grain corn estimated from the objective field measurement surveys, adjusted for the ears and loose kernels left in the field, was 9.0 percent greater than the farmers' mid-September estimate and 15.4 percent greater than the production estimate for the second or October survey. The actual production on the 50 farms visited for the post harvest gleanings and crib measurements in early November indicated the mid-September estimate of production should be increased by 4.2 to 8.4 percent.

The field gleaning data indicated that about 8.3 bushels of corn per acre were left in the fields after the farmers had picked their crop. Crib and bin measurements made in the post-harvest survey indicate the farmer's estimate of bushels of corn in the crib is approximately 35 percent of the crib volume occupied by corn. Since this is about 15 percent less than the figure usually used to convert volume to bushels, it is believed that growers may be understating production by a similar amount.

Weekly visits to determine when the dry matter of corn was laid down were made from September 1 to October 17. The most interesting features of this work are probably:

(1) Kernel surface area decreased 12.5% from Sept. 1 to Oct. 17.
(2) Dry kernel weight increased 40% from Sept. 1 to Oct. 17.
(3) Wet ear weight decreased 13.6% from Sept. 1 to Oct. 17.
(4) Kernel surface areas can be successfully measured through the husk on the corn plant although these figures must be corrected by a regression scheme later.

In addition, the most striking feature of the numerous relationships studied is their linearity.

6.2 Cotton Project at North Carolina State College

This project was concerned with the investigation of techniques leading to improved methods of collecting and utilizing objective measurement and count data for the estimation of cotton production. The main objectives were:

1. To determine the exact specification of the acreage population to be sampled, i.e. the field.
2. To estimate the optimum size of the sample segment within the field.
3. To determine if bias arises from non-random location of samples within the field.
4. To determine the likelihood of bias (and its magnitude if present) in small plot sizes.
5. To investigate relationships between number of bolls, weight of bolls, weevil infestation, etc., and final yield for August 1 and September 1 forecasts.

This project continued some phases of work started the preceding year in regard to optimum size of plot and the relationship of boll counts to yield. In addition, the work involved several procedures not previously used. The Master Sample materials were revised by use of the latest available maps to obtain count units with well-defined boundaries. Open country sampling units or segments had boundaries such as roads, rivers, streams, railroads or other natural features that did not cross the borders of any given field. The only imaginary lines used as boundaries were those defining counties, urban areas, and rural places. The other feature which was introduced involved the use of only the land and fields within the boundaries of the segment being associated with the selected sampling unit or segment without regard to the total land that might be associated with the operators.

Method of Study: A survey was made in early July, covering 25 segments located in Union, Iredell and Cleveland counties in the Southern Piedmont area of North Carolina. During this survey the farmer who operated the cotton fields or other fields, gave his estimate of the acreage in these fields. A systematic procedure was used to select every nth cotton field in the sample segments. During this visit, the selected fields were measured. A sketch of each field was drawn and the dimensions recorded according to instructions used by ASC in 1953. A second visit was made to the sample fields in late July for boll counts. Two sample plots, each containing 25 feet of triple row, were selected by a random procedure such that every row and length of row had an equal chance of getting into the sample. This selection of random plots was made in the office from the field sketches and measurements, and required considerable preparatory work. Boll counts were recorded for each 5 feet of single row. In addition, two sample plots, each containing 10 feet of double row, were selected by the same systematic scheme that was used in the 10-State cotton program. During the last week in August, the same fields were visited and identical counts made in the same 4 segments in the fields. A concluding survey was made during the harvesting season. The purpose of this visit was to pick the cotton that matured within the sample plots. Gleaning information was obtained on two random 25-foot triple row plots after the farmer finished all the harvesting he was going to do.

Results of Study: Various acreage concepts were studied; analysis indicates that (1) the farmers' estimate of acreage was about 1 percent less than the chain measurements, (2) planimeter measurements were about 7.6 percent greater than chained measurements, and (3) the ASC measured acreage was about 5.5 percent less than chain measurements. Possible explanations of these differences are believed to be associated with (1) difficulties of getting accurate readings on large and irregular fields, and (2) difficulties in delineating the boundaries and unplanted areas within fields. This analysis indicates that the difficulties in estimating production may in part be associated with the acreage concept.

The optimum size of plot for boll counts (considering costs) was found to vary from 10 feet of single row, 10 feet of double row, and 10 feet of triple row, depending on the month and whether large or small bolls were counted. When large and small boll counts are combined, the optimum plot size was 10 feet of double row for August 1. On September 1 the optimum was somewhere between 5 feet and10 feet of single row. No bias attributable to size of plot was found over the range of plot sizes studied, i.e., 5 feet of single row to 25 feet of triple row.

The analysis indicates that there was a small bias associated with non-random selection of plots in the fields. That is, the average number of bolls picked was 2.2 percent less for the plots located by the systematic procedure than with a purely random procedure.

7. Operations and Costs

The 1954 Research Program operations can most readily be discussed in 3 sections; the June Interview Survey, the objective measurement work, and the mailed surveys with interview followup of non-respondents. The June Survey was conducted in 100 counties with the sample designed to obtain about 3,000 farms not including cropper units. A total of 703 sample segments were selected with an average of about 4 farms per segment. Objective measurements were made for corn and cotton in 200 fields selected from the June Sample farms for each commodity. In late September, and again in late November questionnaires were mailed to all farmers in the June interview sample. A sample of non-respondents was interviewed for each survey. The remainder of the non-respondents were mailed "second request" questionnaires. The September survey covered crop items while the November survey was devoted mostly to questions on livestock.

7.1 June Acreage Survey

Two forms were used in the survey: (1) A farm Identification form designed to screen persons living inside the boundaries of each segment to determine whether or not they were farm operators, and (2) a farm questionnaire to be filled out for all persons who qualified as farm operators. In this survey a farm questionnaire was filled out for every person living inside the boundaries of a sample segment who qualified as an operator of a farm, regardless of where the land he operated was located. To qualify as a farm operator a respondent had to meet rigid specifications but the burden of making the decision did not rest upon the interviewer. The interviewer was instructed to complete a farm questionnaire for every person that said he operated a farm and for every person in charge of a place not considered a farm by the operator if, during 1954, any poultry or livestock were kept or grazed, any fruit or vegetables were grown for sale, or any other crops were grown. The farm questionnaires were reviewed in the Washington office after the survey was completed and more rigid rules applied to determine which of these places should be considered to be farms. A place was called a farm if it scored 150 points according to a rating system, which was adapted from rules already used by the Census Bureau.

In the enumeration a place was defined as all land operated. This included land owned, plus land rented in, minus land rented out to tenants other than croppers. Croppers were not considered to be farm operators. In this survey a cropper was defined as a person who worked land for others for a share of the crop, with all horses, mules, or tractor power to work the land being supplied by the landlord. To qualify as an operator a person had to be responsible for the day-to-day decisions in the agricultural operations, regardless of whether or not he actually lived on the place. Bona fide tenants were considered operators; share tenants qualified as operators if they furnished their own workstock or tractor power. Managers were considered operators when they actually made all major decisions with respect to the operation. When a manager operated land simultaneously for different people, the aggregate was treated as a single farm. But if in addition to managing land for others he also operated some land for himself, the land operated for himself was considered a separate farm. In the case of a partnership with both parties living

on the place the partner responsible for most of the decisions was considered the operator; when no such distinction could be made, the older was designated. When only one partner lived on the place, he was considered the operator.

A time-table of operations was prepared when work on the project was started. The original schedule and the actual operations dates are shown in the following time-table.

Operations Timing	Proposed	Actual
Preliminary draft of questionnaire submitted to Budget Bureau	March 23:	March 23
Conference with State Statisticians in Montgomery	March 25-26:	March 25-26
Pretest of questionnaire in North Carolina	March 29-31:	March 29-31
Final draft of questionnaire submitted to Budget Bureau	April 6:	April 16
Questionnaire sent to printer	April 19:	April 28
Materials and forms mailed to State offices	April 29-30:	May 5
Final recruiting and appointment of interviewers	Week of May 3	May 3-17
Supervisor training at Atlanta	Week of May 10	May 18-21
Interviewer training at State schools	Week of May 24	May 24-28
Start of interviewing	June 1:	June 1

Questionnaire:

The first draft of the questionnaire was prepared in cooperation with subject matter specialists and submitted to the State Statisticians for the 10 Southern States at a conference in Montgomery, Alabama, on March 25-26. The questionnaire as revised by this group, was pre-tested in North Carolina the week of March 29 by Washington representatives of the Division and the Department's clearance officer and members of the staff of the North Carolina office. A final draft of the questionnaire was then prepared as a result of this experience. An additional pretest of the section on pastures was made in nearby Virginia before the final draft was completed. The final questionnaire was submitted for Budget Bureau clearance on April 16. Clearance was given on April 22 and the final copy was ready for duplication on April 28. The completed supply of questionnaires was delivered by May 5 and mailed to State offices shortly thereafter.

Other forms prepared were a House Identification Form which was used as a screening form to identify persons from whom a schedule was required. The form for keeping a record of time worked and miles traveled was one that had been used in earlier surveys.

The farm questionnaire was of the interview type and consisted of 17 pages in book form and about 150 questions. This may seem quite lengthy, but it must be remembered that the questions were of the interview type so that an interviewer could run through them quite rapidly. Furthermore, only a comparatively small number of questions needed to be asked of every farmer; sections on items not applicable could be skipped in toto. Most of the questions related to planted crop acreages and livestock inventories. Acreage for harvest and production data were obtained for crops normally harvested in late spring and early summer. Data on 1953 acreages and production were asked for some of the important crops to provide a basis for ratio estimates.

In addition to these questions, several others were included to shed light on how farmers interpret some questions asked in this survey and in the regular surveys conducted by the Division. There has always been some doubt, for example, about the units in which farmers report corn yields. In this survey farmers were asked specifically whether they were reporting corn production in terms of bushels of ear corn or shelled corn and how many pounds were regarded as bushel. Another troublesome question in the regular livestock surveys has always been whether a farmer's report on "pigs saved" includes pigs which were sold or given away, as well as those which he kept to raise himself. In this survey every respondent was asked whether or not such pigs were included. If not, he was asked how many pigs were omitted in his reported figure.

It was generally assumed that farmers with croppers would prefer to report crops grown by croppers as part of their own operations. But, to insure that data for croppers were included, the operator was asked specifically whether his reported crop acreages included acreages worked by croppers. When they were omitted, the operator was asked to report on them also. In the case of livestock the operator was asked specifically to report the total number of cattle and hogs on the place, including those kept by croppers. He was then asked specifically for the numbers kept by croppers only, but detailed questions on such matters as ages of animals and milk production were not asked for stock kept by croppers. It was assumed that the operator would not be well enough informed to answer such questions and that the numbers of such animals were not large enough to justify contacting the croppers themselves for the data.

Farm Identification

In most previous farm interview surveys using area sampling, farm identification was based on a farm headquarters, which, by definition, was a point on the farm. For resident-operated farms, the operator's residence was considered the headquarters. But when the operator did not live on the farm, some other point on the farm was defined as the headquarters; that point, in order of preference, was the (1) most valuable dwelling, (2) most

valuable building, (3) main entrance, or (4) northwest corner. After the farm headquarters point was established, a farm was considered associated with a sample segment if its headquarters was inside the segment. To insure complete coverage, all separately-owned or operated tracts of land inside the segment were listed and classified as nonfarm land or part (or all) of a farm. For each tract of land it was necessary to determine:

1. What is a farm?
2. Is this tract a farm or part of a farm?
3. Who is the operator?
4. Does he live on his farm?
5. If the operator does not live on his farm, what land is included by the entire farm?
6. What point is the farm headquarters?
7. Is the headquarters inside the sample segment?

Unfortunately these determinations were frequently made before the exact nature of the farm operations had been established and sometimes it was difficult to provide step by step questions for the interviewer to use in making his decisions.

To simplify the farm identification procedure in the June 1954 survey, a farm questionnaire was to be filled out for every farm operator living within the boundaries of the sample segments, regardless of where the land was located. This concept required the interviewers to determine which individuals actually qualified as farm operators. As indicated earlier, the scale of operations entered into the picture. But the rules were designed to catch all places which might qualify as farms; the credit point system was later applied in the office to reject questionnaires for places having insufficient agricultural activity to qualify. Interviewers identified 3,069 places for which farm questionnaires were required according to instructions. Of these, 246 were later rejected in the Washington office by the point rating system. This left 2,823 farm operators. Because some heavily populated sample segments were subsampled instead of being enumerated completely, the actual number of farm operators present in the sample segments was somewhat larger than this figure; it is estimated that 2,876 were actually present. Of the 2,823 contacted, usable questionnaires were obtained from all but 60. This slight incompleteness occurred for the usual reasons, including a few refusals and inability of interviewers to contact persons who could answer all the questions. Interviewers were instructed to make no more than 3 visits in attempts to locate "not-at-homes."

A more serious difficulty arose in connection with determining whether or not a person being interviewed actually was the bona fide operator of the place under discussion. A farm owner was considered to be the operator if

he had not delegated control of day to day decisions to a manager or to a renter. The manager situation can easily cause trouble because a person who considers himself a manager may not be considered as such by his employer. In that event the owner and "manager" would both classify themselves as operators of the farm; the farm would thus have a double chance of coming into the sample because the owner and "manager" have equal probabilities of selection. This situation was anticipated and interviewers were cautioned to be on the alert to detect cases where a self-styled "manager" might not be a true manager, or conversely, where a farm owner might think of himself as the operator when he had actually delegated the function to someone else. The number of manager-operated farms is quite small, but they usually have extensive operations. At the present time it is impossible to state exactly how effective the instructions and supplementary admonitions were in avoiding misclassifications. All that can be said is that subsequent visits to the small subsamples of farms, used for objective cotton and corn observations, have revealed a few instances where persons were erroneously classified as farm operators. Most were farm owners who had rented their land out to bona fide renters. One was a partner in a farming enterprise in another State; the other partner actually lived on that farm and should have been classified as the operator according to the instructions. As might be expected, such misclassifications seemed to be most common for farm owners who lived away from their farms. Although this situation obviously requires close attention in future surveys, it by no means suggests that the concepts used in this survey should be abandoned. It is necessary to determine who is the farm operator regardless of the nature of the rules used to identify the farms associated with area segments.

But the concept of interviewing operators where they live does make it imperative that interviewers locate all operators living in a segment. Even when no farm land is in evidence, this means that every household in the segment must be covered to be sure that farm operators present will be interviewed. In open-country segments the number of houses is usually quite small and many of them are on farms. But in congested areas and cities a house-to-house canvass of every dwelling becomes a difficult chore with segments of the size used in this survey.

This was anticipated and some general instructions for dealing with the problem were issued prior to the survey. The kinds of heavily populated non-open-country segments which might be encountered were classified roughly into 3 categories:

Type A: Segments with fewer than 50 houses.

Type B: Segments consisting of most of a town of 250 to 5,000 population.

Type C: Congested areas of types other than A or B.

Some densely populated open-country segments were also encountered. Interviewers were instructed to contact every house in the segment if fewer than

50 houses were present. If more than 50 houses were present, interviewers were instructed to consult the supervisor before proceeding.

The supervisor was expected to make whatever decisions seemed most appropriate to fit the particular situation with which he was confronted. Some general guides were provided by the Washington office. In densely populated open-country segments, and others with fewer than 50 houses, the standard procedure of contacting every house should be followed. When more than 50 houses were present, but the segment still was not as densely populated as the Type B segments, the same procedure was to be followed except that call-back requirements were relaxed. When the respondent was not at home on the first visit, and information from neighbors indicated no farm operator lived in the house, no call-back was required.

In Type B segments the "informed-person" technique was recommended. Interviewers were instructed to contact county agents, local offices of other agricultural agencies, bankers, feed and farm implement dealers, and representatives of farmers' organizations, to get the names of persons living inside the segment who might qualify as farm operators. Those persons were then visited to determine whether or not they qualified as farm operators and to fill out farm questionnaires for those who satisfied the requirements.

In Type C segments, which usually consisted wholly or partly of portions of distinct city-type areas, the informed-person approach was also suggested. But this was to be supplemented by a partial canvass of households. The entire area was covered by getting as much information as possible about the presence of farm operators in neighboring houses from one respondent and not actually visiting every house; enough places were visited to account for every house in the segment.

Sometimes part of a segment was of the open-country type with the remainder being densely populated. In such cases the "open-country" portion was covered by the standard procedure.

When it appeared that a congested area contained an excessively large number of persons who might qualify as farm operators, provision was made for visiting only a specified fraction of those that were listed on the preliminary inquiry. But in cases where it was likely that large farming operations might be involved, all such individuals were contacted and subsampling applied only to the remainder.

The following examples indicate the special situations that were encountered in the field and how they were treated. The technique of canvassing houses and getting names of persons in the neighborhood who might qualify as farm operators was the most widely used. It was applied to a segment in North Carolina, 3 in South Carolina, 1 in Tennessee, 1 in Oklahoma, and 5 in Texas. Interviewers reported an average of about 14 farm operators per segment in such segments, but an average of about 3 per segment was eliminated later in the Washington office by the point rating system.

The informed-person approach was applied to two segments in Alabama. One of these was a mill town of 60 houses for which the owner of the mill was able to supply all information--no farm operator lived inside the segment. The other segment consisted of an urban development with a fringe area of open country. The interviewer canvassed the fringe area and located 4 farm operators. By contacting the county assessor, he obtained the names of 7 additional persons in the segment who might qualify. Upon visiting those 7 individuals, 2 of them were found to meet the requirements. Later the supervisor contacted other informed persons in the segment and also canvassed the built up area by the "skip-house" technique. He uncovered 5 additional farm operators by that method.

A similar segment was found in North Carolina. About half of that segment consisted of 20 square city blocks with the remainder being open country. The county agent supplied a list of 23 persons in the segment who might qualify as farm operators. When those were visited 20 were found to meet the requirements. The 23 who were visited were asked to supply names of additional persons who ought to be checked; 7 more farm operators were located by that method. No other general house canvass was made.

A heavily populated segment, which also contained a fringe area, was encountered in Oklahoma. A canvass of the fringe area yielded one farm operator. Contacts with various informed persons yielded a list of 78 additional names, of which 5 appeared to be the operators of large farms. All of those 5 were visited and 4 met the requirements for a farm questionnaire. Of the remaining 73, it appeared that 49 were likely to meet the requirements but that the other 24 might not. To reduce the work load only every other name was selected from each group. Of the 25 in the first group who were visited, 21 actually met the requirements. Of the 12 in the second group who were visited, only 4 met the requirements. Additional names were solicited from the persons who were visited, but no more were obtained.

A densely populated segment in Texas required considerable special attention. The interviewer began canvassing the area before the supervisor gave him special instructions. By the time the supervisor contacted him, he had already interviewed 20 farm operators by starting a canvass of every house. Of these 20, 3 were later rejected by the point system. After looking over the situation the supervisor recommended applying the informed-person approach to the congested part of the segment and making a canvass of the fringe area. Contacts with various informed persons yielded 157 names of which 12 appeared to be operators of large farms. All 12 were interviewed and 9 of them qualified as farm operators. From the remaining 145 names, a sample of 46 was selected for interview by taking every third name; 17 of these qualified as farm operators. The fringe area was then canvassed and yielded 48 farm operators, of which 10 were later rejected by the point rating system. But 6 of these farm operators found in the canvass of the fringe area were also on the list of names obtained from the informed persons. This caused no difficulties other than a bit of extra arithmetic in computing expansion factors for estimating totals for the segment as a whole. But it would have been more logical to canvass the fringe area first and to eliminate names of farm operators found in that area from the informed-person list before drawing a sample from that list.

The above examples do not cover all heavily populated segments which were encountered, but they do illustrate the ways in which they were treated. The last two were the only ones which required so much intensive study.

Training

A training school for State supervisors was held in Atlanta, Georgia from noon of May 18 to noon of May 21. One supervisor was present for each State except for North Carolina. Two persons from the State attended the training sessions. Two men from Georgia, the host State, also attended the training sessions.

Interviewer training schools were held in each State the following week from May 25 to 28. One school was held at a central location in each State except Texas. Two interviewer schools were held in Texas because of the large number of interviewers and the distance to one central location.

In addition to the State supervisors, Washington representatives who were to assist individual States also attended the Atlanta training session. Assistance was furnished all States except Mississippi and North Carolina. States furnished assistance for training only included Georgia, Louisiana, and South Carolina. In Tennessee a man was furnished for training and for 2 weeks of the survey proper. Alabama was furnished a man for training and for an additional week. Arkansas was furnished one man for 4 weeks. In Texas, 3 men assisted with training and 1 remained for 3 weeks to assist in supervision of interviewers. In addition, 2 men were sent to Oklahoma to study methods of handling a large city segment after completing their assistance with interviewer training schools.

The training program was set up in a training manual. The manual was arranged so that the training officer was able to read prepared material almost exclusively. A time-table was included which showed the time allotted for each section. The manual started by explaining the purpose of the survey and the way in which it was designed. Administrative instructions followed. A discussion of maps and aerial photos and practice exercises in their use was the next topic. Instructions on interviewing techniques were next. After that the House Identification Form was discussed and demonstrated after which the class participated in filling out the form for a hypothetical sample segment. The questionnaire was then presented and discussed. A demonstration interview was given by the instructor which not only covered the questionnaire material but also brought out various phases of interviewing techniques. This was followed by practice interviews by members of the class for which the instructor acted as respondent using a completed hypothetical questionnaire.

The preceding training was completed in a day and a half. The following day interviewers were paired off and given a map with a sample segment delineated and instructed to each take an interview in the sample segment and make the necessary entries on a House Identification Form. This was to be completed and the interviewers back in the classroom by 3:00 p.m. for a discussion of field experiences and questions. The final half day was devoted to a review

of the entire process and concluded with the distribution of materials for the actual survey.

Each trainee was given a kit of training materials. This included an "Interviewers Reference Manual," copies of all the necessary forms, and a training map. Aerial photos used for the survey in individual States were used to illustrate the discussion of the use of aerial photos.

The supervisors training school in Atlanta was conducted by the Washington staff using the same agenda and procedures that the supervisors were expected to use in conducting their own training schools. Supervisors received the regular interviewer training which was given in detail in the Training Guide.

The use of a training manual in which the entire program of training was laid out step-by-step provided uniform training for all interviewers and simplified the job of the supervisor in his own training of interviewers.

The training program was set up to obtain trainee participation by including illustrative problems and exercises and portions of reading aloud by trainees. It was discovered at the supervisor training sessions that even more reading aloud by the class than originally planned in the training guide was desirable. Most supervisors reported doing this in their own training schools.

It would probably have been advisable to extend the supervisor training school another day. The time allotted was only sufficient to cover interviewer training. Another day could have been used to give the supervisors practice in using the "Training Guide." For this survey, the supervisors were all professional men from the State offices, many of whom had supervised previous surveys. These men were believed capable of taking the "Training Guide" and using it properly for their own training programs. However, a day of discussion and use of the "Guide" would have simplified their later use of it and made it possible for them to raise questions about sections which were not immediately clear.

Interviewers

Interviewers were hired by State Statisticians, one for each sample county. They were paid at the rate of $1.42 per hour and 7 cents per mile for official auto travel. Per diem at the rate of $8 per day was allowed for attendance at training schools and 3 days salary was paid for the training period.

State Statisticians were supplied with instructions on selecting and hiring interviewers on the basis of previous experiences with large interview surveys. "Interviewer Selection Aids" were also supplied which consisted of simple tests in arithmetic, map-reading and reading comprehension. Some Statisticians were hesitant about using the "Aid" but after using it were generally well satisfied. Many commented that it was valuable in weeding out the poorer candidates. It simplified relations with local persons suggesting interviewers since the test results could be used where necessary to weed out undesirable "favorite sons."

At the completion of the survey, State Statisticians were asked to make a subjective rating of the work of each interviewer, enter it on the completed "Selection Aid" for this interviewer and return the "Selection Aids" to Washington. The ratings were numerical, from 1 to 5, with 1 for outstanding work and 5 for very poor. Analysis of data for 65 interviewers show the following results.

Table 7.1: Distribution of interviewers by combined test grades

Rating	Combined test grades					Total	
	100-90	89-80	79-70	69-60	59-50	Number	Percent
1	6	4	2	--	--	12	18
2	8	13	3	--	--	24	37
3	6	5	10	2	--	23	35
4	1	--	--	2	2	5	8
5	--	1	--	--	--	1	2
Total Number	21	23	15	4	2	65	
Percent	32	36	23	6	3		100

Percent distributions were also prepared comparing interviewers' rating with age and with education.

Table 7.2: Distribution of interviewers by rating, by education

Rating	Education					Total	
	College Graduate	Some College	High School	Grade School	Not reported	Number	Percent
1	4	6	2	--	--	12	18
2	11	8	4	1	--	24	37
3	5	9	6	2	1	23	35
4	1	1	2	1	--	5	8
5	1	--	--	--	--	1	2
Total Number	22	24	14	4	1	65	
Percent	34	37	21	6	2	--	100

Table 7.3: Distribution of interviewers by rating, by age.

Rating	Age					Total	
	20-29	30-39	40-49	50-59	60 & over	Number	Percent
1	3	4	4	1	-	12	18
2	3	9	6	3	3	24	37
3	6	10	7	-	-	23	35
4	1	1	2	-	1	5	8
5	-	-	1	-	-	1	2
Total Number	13	24	20	4	4	65	--
Percent	20	37	31	6	6	--	100

Comments from State project leaders before the beginning of interviewing indicated that in most States interviewers hired were of better quality than for many previous surveys. Final appraisal of interviewer efficiency after completion of the survey showed only 1 interviewer rated very poor and 4 others below average. More than half of the interviewers were rated as above average.

Comparisons between grades made on the interviewers' test and the rating of the interviewers showed considerable correlation between grades and ratings. For those interviewers rated below average, 4 out of 5 made a grade of less than 70 on the test. Correspondingly, half of the group rated as the best made perfect scores on the test.

Education was also correlated with the performance. However, some of these comparisons are inconclusive mainly because about 70 percent of the interviewers had some college education and only 4 had no high school. Of the college graduates, 15 of 22 were rated above average and for those with some college work 14 of 24 were above average. There was apparently little or no correlation between age and performance.

Supervision

Interviewers were instructed to work 2 days and then wait until their work was checked by the State supervisor before continuing work. A system of staggered starts was used so that the supervisor or supervisors could meet each interviewer after he had concluded 2 days work. A definite schedule of meetings was arranged by the supervisor with the interviewers at the conclusion of the interviewer training school. Every interviewer's work was checked and his mistakes corrected before he got into the job very far. Completed questionnaires and other forms were returned to the office of the State Statistician by mail and

and checked as they were received. In the case of serious errors or omissions questionnaires were returned to interviewers by mail for correction.

Field Editing

Field editing consisted of only a check for completeness of coverage and for completeness of questionnaires.

Check-In

As questionnaires, house identification forms, maps and photos were received from the field they were checked first for completeness of coverage. County check-in sheets were set up with a separate line for each sample segment. Data recorded for each segment included number of houses in the segment, occupied and vacant, number of eligible farm operators, resident and non-resident, number of completed questionnaires, and number operators not interviewed and the reason for no interview.

Table 7.4: CHECK-IN SUMMARY

State	Open Country: Occupied	Open Country: Vacant	Non-open country	Operators: Reported: Res.	Operators: Reported: Non-res.	Operators: Edited *: Res.	Operators: Edited *: Non res.	Operators: Edited *: Total	Not a farm	Incomplete: Re-fusal	Incomplete: Other	Sched: tab	% complet
Ala.	385	69	80	248	5	234	5	239	14	1	6	232	97.0
Ark.	357	91	26	244	11	230	11	241	14	-	3	238	98.7
Ga.	417	121	25	210	14	203	13	216	7	1	5	210	97.1
La.	257	28	21	155	6	145	5	150	10	1	2	147	98.0
Miss.	425	79	---	256	1	247	1	248	7	2	-	247	99.2
N.Car.	706	114	---	333	47	318	44	362	16	1	1	360	99.4
Okla.	342	58	---	197	32	185	62	247	12	1	7	215	98.5
S.Car.	755	66	679	209	24	184	20	204	28	2	-	202	99.0
Tenn.	530	76	474	353	8	311	8	319	43	-	1	318	99.7
Texas	862	210	---	627	89	533	117	650	95	4	22	592	96.0
Total	5,036	912	1,305	2,832	237	2,590	286	2,876	246	13	47	2,761	97.9

* Includes estimates for sub-sampling in Oklahoma and Texas.

Washington Editing

Questionnaires were then edited. The first problem was rejection of places that did not qualify as a farm. The Census definition of a farm was accepted. All places of 3 or more acres were counted if they had $150 of production in 1954. For places of less than 3 acres $150 of agricultural production was required. This definition was transposed to a point system similar to that used by the Bureau of the Census in the 1953 Sample Census in Virginia and Utah. By this system a place was required to have a score of 150 points to qualify as a farm. The scoring system follows:

		Points	
		Places of 3 acres or more	Places of less than 3 acres
Hay or pasture:	each acre	30	0
Vegetables or small fruits for sale:	each acre	150	150
Cotton, tobacco, Irish potatoes, sweetpotatoes	each acre	150	150
Other crops harvested	each acre	50	50
Fruit	each acre	150	150
Cattle (excluding calves) on hand	per head	150	50
Calves on hand	per head	50	30
Hogs and pigs on hand	per head	50	25
Sheep and lambs on hand	per head	30	18
Chickens on hand	each	3	2

Editing Instructions

General: Check all sections for completeness and reasonable entries. In cases of omissions edit in an X.

Check schedules to see that place qualifies as a farm. Use the scoring system prepared for 1953 Sample Census. A total of 150 points are required to qualify as a farm. If place does not qualify write across face sheet "not a farm". Place schedule on bottom of pile.

Face sheet:

Circle last call.

Under "Time Interview Began" enter elapsed time of interview in minutes.

A-11 & A-12: If "No" in A-11 and "No" in A-12, that is the acreage this year is different that last year and the operator is not able to give last year's crops for the acres in A-8, place a note at the top of the Face Sheet "Acres different in 1953."

Corn: Make adjustment of production and stocks to bushels where necessary.

Oats: Code items in F-6 as follows: a. -1; b. -2; c. -3; and d. -4. Place code to right of check boxes.

Peanuts: Code L-3a as follows: 1, 2 and 3 in order of possible checks.

Hay crops: Do not make adjustments for duplication of oats, acres or omissions either in hay or crops used for hay in earlier sections. These duplications or omissions will be edited on the listing sheets.

Numbering schedules:

Arrange usable schedules in order by segment and house number except for schedules marked "Acres different in 1953" which should be placed last in the county in the same sort of order. After the schedules are arranged in order in these 2 groupings with those with different acres in 1953 last, number the usable schedules for the county consecutively. Place the number under the title on the face sheet.

Check-in Sheet:

Show in the column headed "No. farm operators', Edited" the number of farm operators after non-qualifying farms are excluded. This should be the sum of the entries in "Res. & Non-Res. Operators" minus the number of schedules discarded because they do not qualify as farms. If any non-resident operators are thrown out show the edited number above the reported number.

Interviewer Performance

The number of farm operators found in the area segments is of administrative and statistical interest. That distribution for the present survey is shown in Table 7.5.

Table 7.5: Numbers of Segments Containing Specified Numbers of Farm Operators.

Farm Operators	Number of Segments	Farm Operators	Number of Segments
0	42	11 - 15	18
1	94	16 - 20	6
2	126	21 - 25	1
3	134	26 - 30	0
4	110	31 - 35	0
5	61	36 - 40	1
6	40	41 - 45	0
7	24	46 - 50	0
8	26	51 - 55	1
9	10	- - - -	--
10	8	113	1

There were only 4 segments containing more than 20 farm operators.

The time required to conduct interviews after contacts with farm operators were established is of some interest also. The average length of an interview was 30 minutes, but there was considerable variation from farm to farm.

Table 7.6: Length of Interviews with Farm Operators

Length of Interview Minutes	Percent of Farm Operators
Less than 12	9.6
13-22	29.2
23-32	28.5
33-42	14.2
43-52	8.7
53-62	4.0
63-89	3.7
90-119	.9
120-over	.4
Not recorded	.9

About 67 percent of the interviews lasted less than 33 minutes and only about 5 percent lasted more than 62 minutes. For all practical purposes, 2 hours can be regarded as the maximum length. But this represents only the time actually spent in the interview itself; it does not include travel time nor time spent at the farm before and after actually asking the questions on the schedule. Long interviews sometimes resulted from complicated large-scale farming operations which needed to be unravelled for proper recording of data. But the personality of the interviewer was also a factor. Some interviewers appear to have been businesslike in getting the pertinent information and concluding the interview; others were more prone to spend time in sociable conversation. The evidence for this can be found in the time records turned in by individual interviewers. The following Table 7.7 shows a distribution of average time per interview for interviewers.

Table 7.7 Relative Numbers of Questionnaires Completed by Specified Dates.

Date	Days Worked	Percent Completion	Date	Days Worked	Percent Completion
May 27 1/	1	0.4	June 14	19	90.5
28 1/	2	.7	15	20	93.8
29 1/	3	1.3	16	21	95.8
30 2/	4	1.3	17	22	97.4
31	5	12.0	18	23	97.7
June 1	6	21.4	19	24	98.6
2	7	31.0	20 2/	25	98.6
3	8	41.0	21	26	98.8
4	9	49.3	22	27	99.1
5	10	52.0	23	28	99.2
6 2/	11	52.1	24	29	99.4
7	12	60.4	25	30	99.7
8	13	69.1	26	31	99.8
9	14	76.3	27 2/	32	99.8
10	15	81.6	28	33	99.8
11	16	85.5	29	34	99.9
12	17	86.7	30	35	100.0
13 2/	18	86.7			

1/ Instruction period.
2/ Sunday.

The low level of completion during the first 4 days was caused by restrictions imposed upon the amount of work interviewers were permitted to do, before their work was checked by the supervisor, and by the fact that May 29 was a Saturday and May 30 a Sunday. Hardly any interviewing was ever done on a Sunday, and work on a Saturday was generally at a lower level than for Monday through Friday. Most of the interviews after June 21 were made in North Carolina and Oklahoma.

Table 7.8 Distribution of Interviewers by Average Time per Interview.

Time in Minutes	Interviewers	
	Number	Cumulative percent
Under 15	1	1
15 - 19.9	12	13
20 - 24.9	19	32
25 - 29.9	19	51
30 - 34.9	18	69
35 - 39.9	13	82
40 - 44.9	9	91
45 - 49.9	4	95
50 - 54.9	2	97
55 - 59.9	1	98
60 - 69.9	1	99
70 - 79.9	1	100
Total	100	-

Actual time worked for interviewers varied from State to State for various reasons. Some of the variations were due to type of farming, the proportion of large and small scale farming operations, availability of farm operators for interview, distance between farms and the ability and diligence of individual interviewers. The following Table 7.9 shows average time per questionnaire for different phases of the job and other pertinent performance data.

Table 7.9: Interviewer performance measured by averages of time per usable questionnaire, questionnaires per 8-hour day and miles travel per questionnaire.

State	Time per usable questionnaire					Questionnaires per 8-hour day	Miles per questionnaire
			Survey				
	Total	Training	Total	Interview	Other		
	Hours	Hours	Hours	Hours	Hours		
Alabama	3.23	.93	2.30	.50	1.80	3.5	16.2
Arkansas	3.17	1.01	2.16	.57	1.59	3.7	19.4
Georgia	3.95	1.03	2.92	.57	2.35	2.7	20.6
Louisiana	2.53	.82	1.71	.40	1.31	4.7	19.5
Mississippi	3.17	1.07	2.10	.52	1.58	3.8	15.9
North Carolina	3.57	.87	2.70	.52	2.18	3.0	22.0
Oklahoma	3.79	.78	3.01	.48	2.53	2.7	20.7
South Carolina	3.06	.83	2.23	.44	1.79	3.6	17.5
Tennessee	3.32	.75	2.57	.57	2.00	3.1	16.9
Texas	3.01	.70	2.31	.43	1.88	3.5	20.2
Total	3.27	.85	2.42	.50	1.92	3.3	19.1

Costs

Cost estimates were prepared after the sampling scheme and the expected number of interviews was tentatively established to see if the proposed survey costs would be within the established budget allowance. The first cost estimate was made on an overall basis for all out-of-pocket field costs. Data on expected interviews per 8-hour day and miles traveled per interview were established on the basis of previous surveys. Training school costs were set up for the entire project. The following Table 7.10 shows these estimates and the actual costs reported when the work was completed.

Table 7.10 First Estimate of Costs and Actual Costs

	Estimated Cost	Actual Cost
Training		
Salary	$3,438	$3,351
Travel	1,741	1,300
Per diem	2,076	2,796
Total	7,255	7,447
Survey		
Salary	11,106	9,526
Travel	4,101	3,688
Total	15,207	13,214
Grand Total	$22,462	$20,661

A second set of cost estimates was prepared later, by States, to be used in allotting funds to individual States. This series of estimates was in much greater detail than the first estimate and also included absorbed costs. Each step in the operations process was estimated separately. The steps involved

included interviewer training and the survey proper for interviewers and for State office personnel included training of State supervisors, hiring interviewers, training interviewers, and supervision during the survey itself. The following Table 7.11 shows these estimates compared to the actual costs.

Table 7.11: Detailed Estimated Field Costs and Actual Costs.

	Out-of-pocket costs		Absorbed costs	
	Estimated	Actual	Estimated	Actual
INTERVIEWERS				
Training				
Salaries	$3,375	$3,351	-	-
Travel	1,519	1,300	-	-
Per diem	2,873	2,796	-	-
Total	$7,767	$7,447	-	-
Survey				
Salaries	11,106	9,526	-	-
Travel	4,101	3,688	-	-
Per diem	-	32	-	-
Total	$15,207	$13,246	-	-
Total Interviewers Cost	$22,974	$20,693	0	0
STATE OFFICE				
Supervisor training				
Salaries	-	-	$1,076	$1,173
Travel	472	366	-	-
Per diem	453	432	-	-
Other	-	16	-	-
Total	$925	$814	$1,076	$1,173
Hiring interviewers				
Salaries	-	87	2,189	3,539
Travel	260	355	-	-
Per diem	768	513	-	-
Other	-	1	-	-
Total	$1,028	$956	$2,189	$3,539

Continued -

Table 7.11. Detailed Estimated Field Costs and Actual Costs --Cont.

	Out-of-pocket costs		Absorbed costs	
	Estimated	Actual	Estimated	Actual
Interviewer training				
Salary	-	3	1,049	2,189
Travel	34	91	-	-
Per diem	180	92	-	-
Other	-	26	-	-
Total	$ 214	$ 212	$1,049	$2,189
Supervising survey proper				
Salary	-	212	2,233	2,845
Travel	550	798	-	-
Per diem	840	521	-	-
Other	-	9	-	-
Total	$1,390	$1,540	$2,233	$2,845
Other expenses				
Salary	-	74	-	1,891
Other	-	205	-	-
Total	0	$ 279	0	$1,891
T O T A L				
Salary	$14,481	$13,253	$6,547	$11,637
Travel	6,936	6,598	-	-
Per diem	5,114	4,386	-	-
Other	-	257	-	-
Total	$26,531	$24,494	$6,547	$11,637

Final cost data for all phases of the survey are shown in the following Table 7.12

Table 7.12. Final and Complete Cost Data 1/

	Out-of-pocket	Absorbed	Total
Washington			
Preparation of sample, questionnaire, etc.			
Salaries, clerical	--	$1,440	$1,440
Materials			
Sample	690	--	690
Duplication	692		692
Total	$1,382	$1,440	$2,822
Pretest 2/			
Salaries	--	735	735
Travel	320	--	320
Total	$ 320	$ 735	$1,055
Survey			
Salaries	--	2,753	2,753
Travel	2,909	--	2,909
Total	$2,909	$2,753	$5,662
Supervision			
Salaries	--	3,476	3,476
Tabulation and analysis			
Salaries, clerical	--	2,927	2,927
Total	$4,611	$11,331	$15,942

Continued-

Table 7.12. Final and Complete Cost Data 1/---Cont.

	Out-of-pocket	Absorbed	Total
Field			
Interviewers			
Salaries	$12,877	--	$12,877
Travel	7,816	--	7,816
Total.....	$20,693	--	$20,693
Office			
Salaries	376	11,638	12,014
Travel	3,167	--	3,167
Other	260	--	260
Total.....	$3,803	$11,638	$15,441
Total Field.....	$24,496	$11,638	$36,134
Grand Total.....	$29,107	$22,969	$52,076

1/ Not including salaries of Research Staff personnel.

2/ Including some field costs.

Field costs per questionnaire are usually of interest and also of value in estimating costs of future surveys. The cost per unit data presented in Table 7.13 are shown for various parts of the operations.

Table 7.13. Costs per usable questionnaire for various phases of operations, by States

State	Field cost per usable questionnaire								
	Interviewers			Office			All		
	Training	Enumeration	Total	Out-of-pocket	Absorbed	Total	Out-of-pocket	Absorbed	Total
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Ala.	2.82	4.39	7.21	1.18	3.36	4.54	8.39	3.36	11.75
Ark.	3.05	4.43	7.48	.77	3.79	4.56	8.25	3.79	12.04
Ga.	3.22	5.74	8.96	2.10	5.30	7.40	11.06	5.30	16.36
La.	2.17	3.80	5.97	1.78	5.79	7.57	7.75	5.79	13.54
Miss.	3.33	4.09	7.42	1.38	4.43	5.81	8.80	4.43	13.23
N.Car.	2.76	5.45	8.21	1.01	4.28	5.29	9.22	4.28	13.50
Okla.	2.39	5.72	8.11	1.72	5.69	7.41	9.83	5.69	15.52
S.Car.	2.42	4.38	6.80	1.12	4.33	5.45	7.92	4.33	12.25
Tenn.	2.74	4.84	7.58	1.72	3.53	5.25	9.30	3.53	12.83
Texas	2.33	4.70	7.03	1.34	3.61	4.95	8.37	3.61	11.98
Total	2.70	4.80	7.50	1.38	4.22	5.60	8.88	4.22	13.10

7.2 October 1 and December 1 Production and Livestock Surveys

The field activities were under the direction of the Special Statistics Branch in cooperation with the State Statisticians of the States concerned. In late September and again in late November, questionnaires were mailed from State offices to all eligible farms in the June research survey. A subsample of about 500 nonrespondents to each survey was interviewed. To cluster the interviewing a subsample of segments was drawn. All segments which totaled 3000 acres or more of farm land were included. Every fourth segment of the remaining segments was drawn. All nonrespondents in each of the selected segments were to be interviewed. In the event the expected number of nonrespondents in a county was too large to be interviewed in one or two days, a subsample of only 15 names was drawn for the county. A second request was mailed to all the remaining nonrespondents to the initial inquiry who were not to be interviewed.

Questionnaires

The questionnaire was drafted and prepared in Washington in cooperation with subject matter specialists. The crop items covered in the October 1 Survey were acreage, abandonment, utilization, and yield. The December 1 survey related to livestock numbers and some information on a few late crops. The same schedule was used for all eligible operators receiving mailed questionnaires as was used in interviewing nonrespondents.

Interviewers

In most cases the interviewers used in the June Survey were again available. No formal training school was held, but interviewer's instructions were prepared. The interviewer was supplied in advance of the survey with the names of all operators in the selected segments. The date the nonrespondent interviewing was to begin, the enumerator was called by telephone and told which operators he was to contact. Enumerators were instructed to obtain schedules from all operators on their lists who had not responded by the cutoff date, even if they indicated a schedule had been mailed. The interviewing was completed in one or two days and the schedules mailed to the State Office in time for transmission to Washington by the Crop Report release date.

In most cases the interviewers used in the June Survey were again available. The interviewing was completed in one or two days and mailed to the State Office in time for transmission to Washington by the Crop Report release date. No formal training school was held, but interviewer instructions were prepared for the surveys.

Costs

The State office cost of the October 1 and December surveys was about $8400 of which 56 percent was "out of pocket" cost. The principal item in the "out of pocket" was $3600 for interviewing 1007 nonrespondents in the two surveys. A summary of the "out of pocket" and "absorbed" costs is given below.

Table 7.14 -- Field Costs - Oct. 1 and Dec. 1 Mail Surveys with Nonrespondent Follow-ups

	"Out of Pocket" Cost
Interviewers	
Salary	2274.17
Mileage and per diem	1311.25
Professional personnel	
Mileage and Government car	189.32
Per diem	153.50
L. A. Clerks, salary	429.51
Other expenses	294.70
Total, out of pocket	4652.45
	Absorbed Cost
Professional personnel, salary	2519.27
Regular Clerks, salary	1169.16
Total, absorbed	3688.43
GRAND TOTAL	8340.88

7.3 Objective Yield Surveys.

The field activities were under the direction of the Special Statistics Branch in cooperation with the State Statisticians of the States concerned. The schedules and forms used were developed by a series of conferences among the personnel of the Washington office, but of necessity these forms did not have the benefit of pretesting under conditions that were to be encountered as of the date of each survey. A central training school for the State Office and Washington personnel supervising the work was not held. Instead, a one day training school was held in late July and August for the Washington people who were to assist the State supervisors. A similar one-day training session was held in each State on the Friday before the surveys were to begin. The hired enumerators and State office personnel who were to participate in the work spent a part of the day in several fields located close to the State Office making plant counts and carrying out the field procedures prior to the first cotton survey in July and the first corn survey in late August.

The field costs of the cotton and corn surveys totaled $22,619 of which 10,722 were out of pocket costs and $11,897 were absorbed costs. In the table which follows only the total costs are considered; the breakdown between out of pocket and absorbed costs has little meaning as related to the cost of carrying out the surveys except to indicate the extent to which the field office staffs carried the work load.

Table 7.15 - Costs of Cotton and Corn Yield Surveys - 1954

Item	August 1 Cotton Survey	Sept. 1 Cotton and Corn Surveys	Oct. 1 Corn Survey	Post-Harvest Cotton and Corn Surveys
Number of Usable Schedules				
Fields	186	342	144	178
Farms	163	167		298
Total of Man Hours	1348	2322	1212	1566
Salaries	3233.34	5245.52	2952.90	3802.14
Mileage & Travel Costs	655.65	1073.00	636.41	785.28
Per Diem	809.63	1404.00	642.75	1010.40
Supplies & Other Costs	187.74	97.09	32.97	286.99
Total costs	4886.36	7820.61	4265.03	5647.21
Average Cost per Field Visited	26.27	22.22	26.17	16.76
Average Cost per Field Sampled	26.27	22.87	29.62	31.73
Average Cost per Usable Schedule	19.62	15.36	-----	11.86

The field costs were quite high due to the utilization of a large number of people from the Field Office Staff for field count work. To the extent part time or temporary help can be used, savings of approximately $2 per man hour can be realized.

A study of the average time requirements for various steps of the field work for the August 1 Cotton Survey are given in Table 7.16.

Table 7.16 Approximate Time per Team Per Farm Spent for Various Phases of the Field Work - August 1, 1954

Phase	Number of Minutes
Length of farm interview	19
Locating sample field after interview	13
Sample plot counts	48
Between farms	91
Remainder of Time (preparation travel to and from sample counties, etc.)	50